HARVARD MEDICAL SCHOOL

Putting People First: The Healing Power of Indoor Air

Seminar 21: Sunday, February 2, 2020, 1:30 PM

ORLANDO 2020 WINTER CONFERENCE AND AHR EXPO

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Presentation Summary

We have much to celebrate!	• My path to you • Buildings, medicine, analytics
What the world is calling for now	• Topics in the news • Re-searching health and buildings
Co-constructing our future	• Driving large-scale change • The value of healthy humans

Learning Objectives

1. Provide a data-driven description of indoor environmental factors that are associated with occupant health.
2. Learn the application of energy-saving and hygienic approaches to active humidification when supplementation is necessary as an intervention for dry air.
3. Provide building owners a cost-benefit analysis of occupant health as a building performance metric.
4. Understand the relationship between water in the liquid and vapor state and the human body.

My journey to you, starting in Papua New Guinea, 1983

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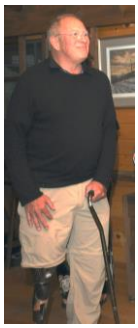
Non-hygienic hospital conditions, yet few infections

Wewack General Hospital, Papua New Guinea 1983

Yet, in USA 1,700,000 patients/year get a Healthcare-Associated Infection



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"Never underestimate the power of the environment!"

Harvard Medical School
Chief-of-Surgery, M. Judah Folkman, M.D.
working with medical student, S. Taylor, 1986

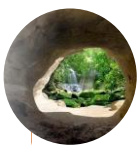
Topics in the news

US on track for one of the worst flu seasons in decades

This year's flu season is taking deadly aim at kids

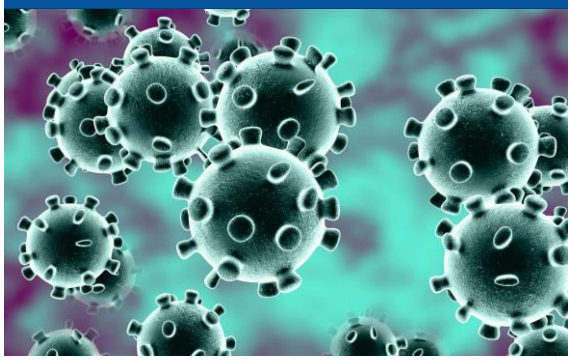
Advances in the built environment

timeline:	10,000 BC	800 BC - 500 AC	1900 AC	2020
housing:	primitive housing no sanitation systems	simple sanitation, in rural villages	industrial revolution central sewage & water systems, heating, electricity	post-industrial cities, tighter buildings, dryer and warmer indoor air



Topics in the news – Wuhan Coronavirus

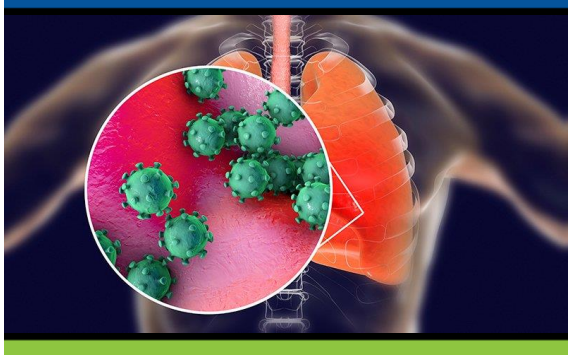
2019–nCoV



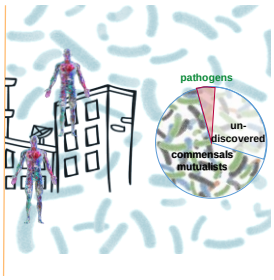
Co-evolution of buildings and infectious diseases

timeline:	10,000 BC	800 BC - 500 AC	1900 AC	2020
housing:	primitive housing no sanitation systems	simple sanitation, in rural villages	industrial revolution central sewage & water systems, heating, electricity	post-industrial cities, tight buildings, dryers, warmer indoor air
infectious diseases:	parasites, zoonosis	1st epidemics: small pox, measles, influenza, plague	1st pandemic "Spanish flu" introduction of antibiotics & vaccines	Increasing infections, zoonotic transmis.,ABX-resistant bacteria

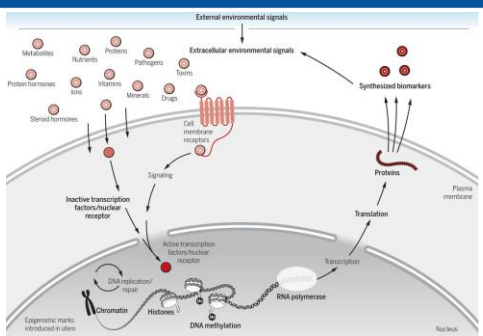
2019–nCoV



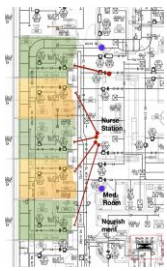
Genetic analysis tools reveal a vast microbial world

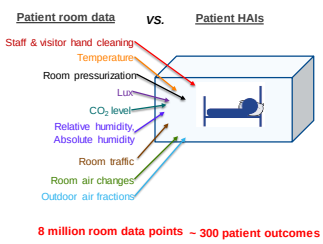


Environmental factors contribute to genetic mutation



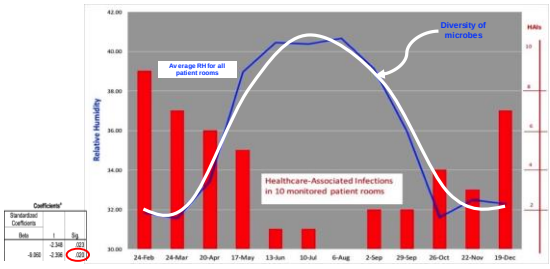
What indoor factors correlate with infections?





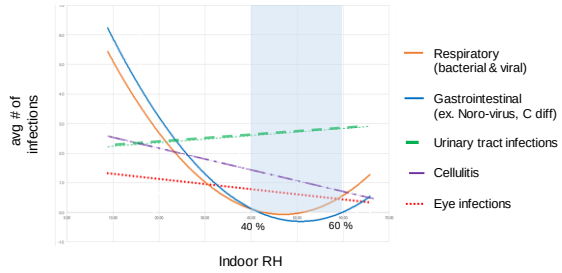
8 million room data points ~ 300 patient outcomes

As patient room RH went down, infections went up!



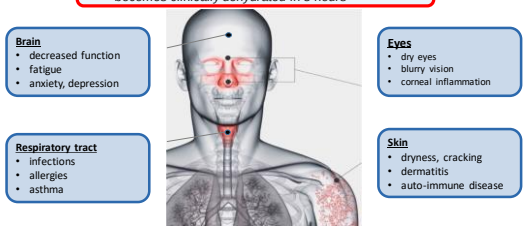
The elephant *is* the room

Infection rates were lowest when RH = 40-60%



When RH<40%, humans suffer!

Sitting in room air with 20% RH, the average person becomes clinically dehydrated in 8 hours



2018: Humidity decreased Influenza A illness in a pre-school

January 25 – March 11 (32 days)

Half of the classrooms were humidified, the other half were not

RH of classrooms	% Airborne particles carrying virus (PCR)	Virulence of airborne virus	# children absent due to influenza illness
20%	49%	75%	**22**
45%	19%	35%	**9**

When RH < 40%, pathogen infectivity is high

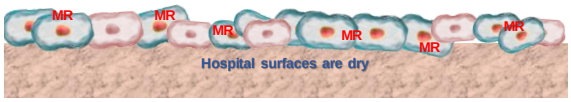
Greater aerosol transmission

Evasion from surface cleaning through resuspension

Increased survival and virulence of pathogens

The majority of bacteria causing HAIs survive very well in the air

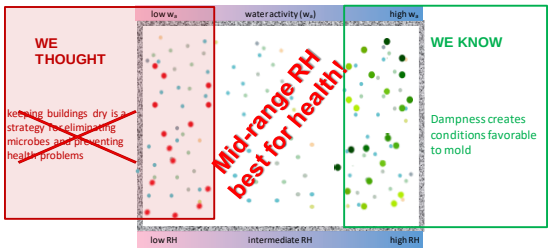
Acinetobacter supp.	3 d	up to	**5 months**	6 references
Clostridium difficile (spores)	7 d	up to	**5 months**	3 references
Escherichia coli	1.5 h	up to	**16 months**	10 references
Enterococcus supp. incl. VRE und VSE	5 d	up to	**4 months**	4 references
Klebsiella supp.	2 h	up to	**>30 months**	5 references
Pseudomonas aeruginosa	6 h	up to	**16 months**	7 references
Staphylococcus aureus, incl. MRSA	7 d	up to	**7 months**	6 references



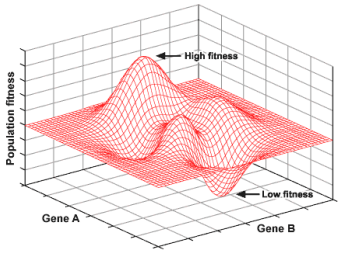
reaction to hospital's dry environment → increased infectivity

Indoor moisture influences health in ways contrary to our intuition

this is not correct!



Fitness mapping of survival changes in low RH



Pathogens thrive

- increased disease transmission
- greater resistance to medications

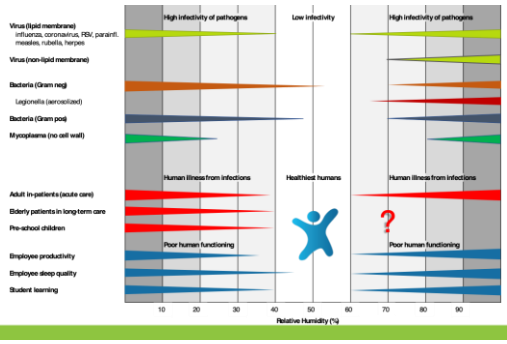
Humans suffer

Now how would you think about the low infection rate?

Wewack General Hospital, Papua New Guinea 1983

Factors:
1. good RH indoors
2. no selection for pathogen virulence
3. people have robust immunity

Taylor Chart 2019



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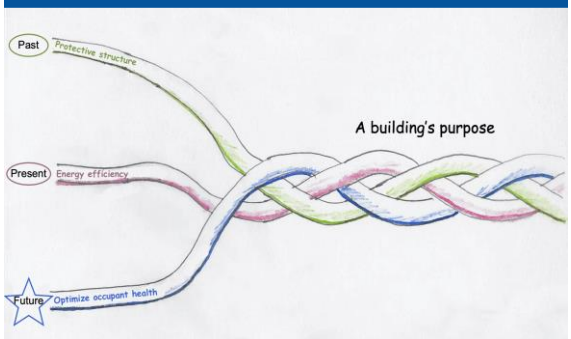
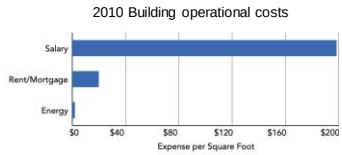
Building design and operation criteria

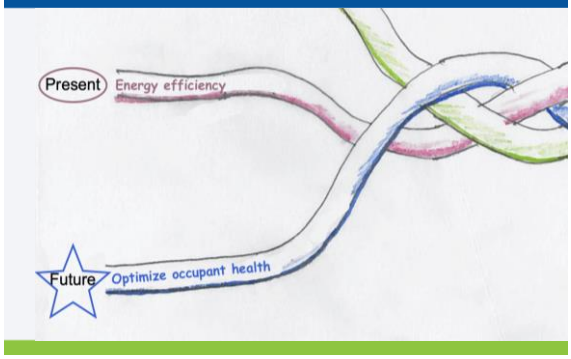


Financial losses from employee sickness are huge



Communicable respiratory illness costs the workforce U.S. $225B per year (2016)

Building design and operation criteria



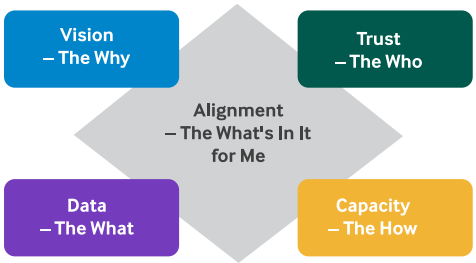
HAIs are very costly for hospitals

The six most common healthcare-associated infections

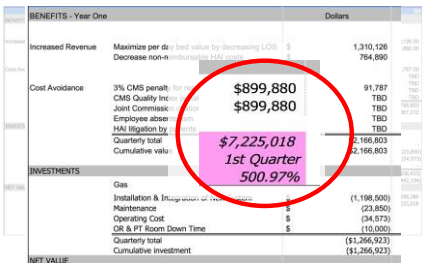
Costs to a 250 bed hospital

	Total Infections	Total Excess Costs	Total Excess Hospital Days
Urinary Tract Infections	1,296	$1,435,968	2592.0
Surgical Wound Infections	365	$7,042,464	4378.0
CRBSI	148	$4,990,636	2509.0
VAP	15	$401,369	170.0
MRSA	120	$927,162	646.0
CDIFF	122	$500,200	733.0
TOTAL	**2,066**	**$15,297,799**	**11,028.0**

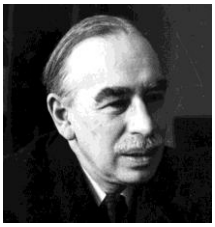
Leading change at scale



Value analysis of humidification in 250-bed hospital



Einstellung effect –our past constrains us



John Maynard Keynes
1883-1946

"The difficulty lies not so much in developing new ideas as in escaping from old ones..."

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Sub-four magic – The power of thinking

Roger Bannister (25), May 6, 1954 ***3:59.4***

- Attempted since 1886
- Became a psychological and physical 'barrier'
- Within 46days (1), a year (3), 50yrs (1,000) more

Presented by:

Stephanie Taylor, M.D., M. Arch., ASHRAE DL
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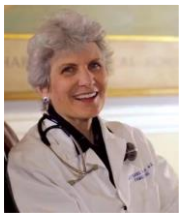

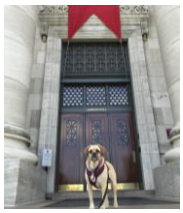

Together, we can do this!

Indoor-air hydration is powerful medicine that is essential in buildings that truly protect our health!

Building factors:

1. Rethink building design and use of spaces (bee-hive)
2. New materials for building shells to avoid condensation
3. Use of materials which have adsorptive properties

Changes in disease prevention and management

1. Clinical practices (prescribe humidifiers)
2. Use of materials which have adsorptive properties

Changes in education

1. Engineers will learn more medicine
2. Physicians will learn more engineering