2020

Annual Report

WELL LIVING LAB

Founded as a collaboration of Delos and Mayo Clinic

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DISCOVERY.
TRANSLATION.
APPLICATION.

Dear Colleagues,

We are pleased to introduce the Well Living Lab (WLL) Annual Report, highlighting past year accomplishments and a look at the future and what lies ahead.

The unprecedented challenges of the COVID-19 pandemic tested and proved our Lab's resilience, multidisciplinary teamwork, and agility, thus making it the ideal time to launch this new annual practice.

The past year has also affirmed the power of partnerships, with significant contributions from our WLL Scientific Advisory Council, WLL Alliance, and new academic collaborators to advance our mission of transforming human health and well-being in indoor environments.

Our Lab embraces the same research framework as Mayo Clinic: Discovery - Translation - Application. Faster translation and application of scientific discoveries to personal, societal, and commercial benefit is a priority, and partnership with all of you helps to accelerate our pace.

The world needs our discoveries to make all of our indoor environments - homes, offices, hotels, vehicles, schools, senior living facilities, restaurants, stores - places through which we improve human health and well-being.

Our future includes an ambitious plan to conduct research in the field, beyond the walls of our Lab. This brings us closer to the person in our pursuit of applying science-based solutions to improve the human condition.

Sincerely,

Barbara Spurrier, MHA
Executive Director, Well Living Lab; Executive Vice President, Delos

Veronique Roger, MD, MPH
Research Director, Well Living Lab; Professor of Medicine & Epidemiology, Mayo Clinic College of Medicine

Nick LaRusso, MD
Chair, Well Living Lab Scientific Advisory Council; Charles H. Weinman Professor of Medicine, Biochemistry and Molecular Biology; Distinguished Investigator of The Mayo Foundation

WELL LIVING LAB 2020:
By The Numbers

22 Multidisciplinary Team Members

4 Strategic Goals

15 Completed Research Studies **&**

12 Peer-Reviewed Publications

25 Well Living Lab Global Alliance Members

5500 Square Feet of Reconfigurable Space

1 Formal Academic Affiliation

UNIVERSITY OF MINNESOTA
Driven to Discover®

2020

WELL LIVING LAB™

STRATEGIC GOAL UPDATES

ADVANCE THE SCIENCE

THE RESEARCH ROADMAP

The Well Living Lab's long-term research objective is to improve human health and well-being across the lifespan. Our three-year research plan sets the stage for achieving this objective by examining specific environmental interventions.

MISSION

Transforming human health and well-being in the indoor environment.

CENTRAL QUESTION

What if the places we live, work, learn, and play improved health and well-being across the lifespan?

FRAMEWORK

Discovery

Translation

Application

PRIORITIES

DESIRABLE

Anchored around scientific exploration and human needs

VIABLE

Informed by assets and capabilities of Delos, Mayo Clinic, and partner organizations

POSSIBLE

Bolstered by technology

HEALTHY HOME

HEALTHY OFFICE

HEALTHY COMMUNITY

Strategic Objectives 2020-2021

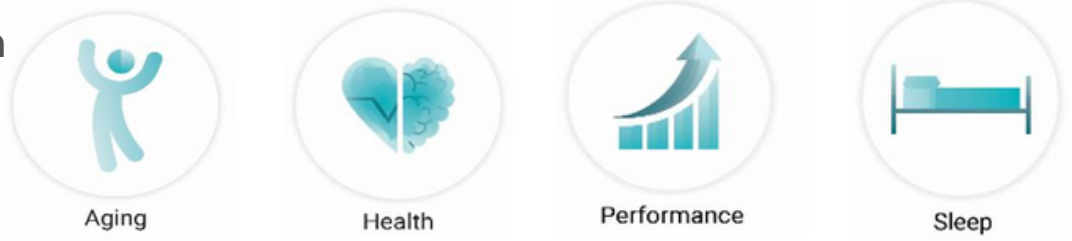
1 Advance the science by conducting translational studies relevant to human health.

2 Expand scientific collaborations with Mayo Clinic & select academic centers.

3 Optimize research operations & expand capabilities.

4 Enhance communications with the scientific community & key stakeholders.

Research Themes



THE RESEARCH TEAM

The Well Living Lab's multidisciplinary research team consists of experts in biomedical engineering, building science, human physiology, behavioral science, technology, and more. By merging these diverse areas of expertise, we can conduct original, translational research that better addresses the complex interaction between health and the indoor environment.

The Scientists

Sara Aristizabal, Ph.D., Research Scientist, Biomedical Engineering and Physiology

Dr. Aristizabal holds a Ph.D. degree in Biomedical Engineering and Physiology from Mayo Clinic Graduate School of Biomedical Sciences. She has worked on the development of algorithms for optimization of wearable devices. Dr. Aristizabal has been involved in an Initiative for Medical Equipment Sustainability (IMES) at Mayo Clinic, which aims at enhancing medical equipment availability and sustainability in Central America.

Meng Kong, Ph.D., Research Scientist, Building Science, Mechanical & Aerospace Engineering

Dr. Kong has more than 10 years of research experience in built environmental and energy systems. He earned his Ph.D. in Mechanical and Aerospace Engineering from Syracuse University where he then worked as a postdoc and research assistant professor for two years. Dr. Kong's Ph.D. work focused on developing a micro-environmental control system for improving thermal comfort, indoor air quality, and building energy efficiency. He has led research projects on indoor and outdoor air quality control, including airborne transmission of SARS-CoV-2.

Kevin Mazurek, Ph.D., Research Scientist, Electrical Engineer & Neuroscientist

Dr. Mazurek earned his M.S. and Ph.D. in Electrical Engineering from Johns Hopkins University where he developed prototype hardware systems for restoring walking to individuals with spinal cord injury. Dr. Mazurek completed a postdoc in Neuroscience at the University of Rochester NY where he worked as a Research Assistant Professor in Neuroscience. He is applying his interdisciplinary training to understand how individuals perceive and process different features of their environment and how these features could be optimized to improve quality of living and overall health.

THE RESEARCH TEAM

The Scientists

Jovan Pantelic, Ph.D., Research Scientist, Building Science

Dr. Pantelic has spent the last 17 years researching various topics related to indoor air quality. He joined the Well Living Lab after working as Professional Researcher at the University of California Berkeley and Lawrence Berkeley National Laboratory, where he is completing COVID-19-related work. His research on air spans from the airborne spread of infectious diseases in the built environment to the impact of large-scale episodic pollution events, such as wildfires. For the past seven years, Dr. Pantelic has worked in the field on Internet of Things (IoT) sensing and is considered as one of the leading experts in the field.

Zachary Pope, Ph.D., Research Scientist, Human Physiology & Behavior

Dr. Pope is a physiologist with additional expertise in behavioral science. Dr. Pope was previously a National Heart, Lung, and Blood Institute T32 Postdoctoral Fellow within the University of Minnesota's School of Public Health, Division of Epidemiology and Community Health. He earned his doctorate in kinesiology, with a minor in public health, at the University of Minnesota. His master's and undergraduate degrees are from Boise State University where he studied exercise physiology, with an emphasis in the pathophysiology of disease.

Rongpeng Zhang, Ph.D., Research Scientist, Building Science

Dr. Zhang's primary research focus is building performance modeling and simulation-based optimization of building design and operation. He works on the built environment control, building technology evaluation, and building energy system operation to support the lab's multidisciplinary research on building-human interactions. Dr. Zhang earned a Ph.D. in Building Performance and Diagnostics program from Carnegie Mellon University.

The Analysts

Kunjoon Byun, M.A.

Linhao Li, M.S.

Qingyang Liu, M.S.

Araliya Senerat, M.P.H., P.M.P.

THE RESEARCH
Completed Studies through 2020

2016

ENVIRONMENTAL COMFORT (OFFICE)

2017

DAYLIGHT-COGNITIVE FUNCTION (OFFICE)
BLUE ENRICHED LED SLEEP (OFFICE)
HIGH STRESS MEASUREMENTS (PILOT)
SCENT DIFFUSION IAQ (PILOT)

2018

DYNAMIC LIGHTING (OFFICE)
SLEEP MICROCLIMATE (RESIDENTIAL)

2019

COGNITIVE FUNCTION IN CONSTRUCTION (FIELD)
COGNITIVE FUNCTION DURING HYPOXIA (FIELD)
BIOPHILIC OFFICE DESIGN (OFFICE)
IAQ IN SKYWAYS AND SUBWAYS (FIELD)
AUTOMATED WAKE-UP (RESIDENTIAL)
MOBILE ENVIRONMENTAL SENSOR DEPLOYMENT (FIELD)

2020

OCCUPANCY SENSOR TESTING (OFFICE)
ARPA-E (OFFICE)
SURFACE: VSV DISINFECTION (COVID)

RESEARCH PROGRAM
COVID-19 & Beyond: Safe Indoor Environment

>50% COVID-19 INFECTIONS RESULT FROM PRE- OR ASYMPTOMATIC TRANSMISSION.*

PROGRAM OVERVIEW AND GOALS

The COVID-19 pandemic has created immense challenges worldwide. While several vaccines have been approved and are being distributed, widespread and adequate vaccination to provide herd immunity will take time. Asymptomatic spread of the SARS-CoV-2 virus, which causes COVID-19, continues to contribute to most COVID-19 infections. With SARS-CoV-2 spreading most easily indoors, the impact of these spaces on health and well-being is more important than ever and effective infection control strategies are critical.

In June 2020, the WLL launched the COVID-19 & Beyond: Safe Indoor Environment Program with two primary goals for both the COVID-19 and post-COVID-19 eras:

1. Generate evidence optimizing the physical indoor environment, including ventilation, filtration, and room layout; and
2. Generate evidence optimizing psychosocial responses, such as stress, anxiety, and safety.

Alliance members Cushman & Wakefield, Empire State Realty Trust, and Hines contributed their expertise to the COVID studies, helping to promote safer post-COVID workplaces upon return to the office environment.

STUDY FOCUS AREAS

1 AIR

2 SURFACE

3 BEHAVIOR

*Johannson M, Quandelacy T, Kada S, et al. SARS-CoV-2 transmission from people without COVID-19 symptoms. JAMA Network Open. 2021;4(1). doi: 10.1001/jamanetworkopen.2020.3505; Polyakova M, Kocks G, Udalova V, Finkelstein A. Initial economic damage from the COVID-19 pandemic in the United States is more widespread across ages and geographies than initial mortality impacts. PNAS. 117(45):27934-27939. doi: 10.1073/pnas.2014279117.

RESEARCH PROGRAM
COVID-19 & Beyond: Safe Indoor Environment

AIR

RESEARCH QUESTION

How do SARS-CoV-2 (the virus causing COVID-19) and similar respiratory viruses spread through airborne means?

AIM OF STUDY

Understand how SARS-CoV-2 and similar viruses are spread through the air using a breathing simulator.

STUDY METHODS

- A breathing simulator was used to accurately mimic the human inhalation/exhalation cycle.
- Fluorescent tracer particles were ejected from a simulator similar to the size distribution from a breathing individual and large enough to carry viral RNA.

RESULTS

- Particles within approximately six feet of the infectious source are likely to deposit onto surfaces, potentially before inactivation.
- Particles beyond six feet are likely to be removed by the HVAC system, regardless of ventilation and filtration settings.

RESEARCH TEAM

WELL LIVING LAB

Zachary Pope, PhD, Lead Scientist

UNIVERSITY OF MINNESOTA, DEPARTMENT OF MECHANICAL ENGINEERING

Chris Hogan, PhD, Professor, Mechanical Engineering;
Editor-in-Chief, Journal of Aerosol Science

Jiarong Hong, PhD, Associate Professor, Mechanical Engineering

RESEARCH PROGRAM
COVID-19 & Beyond: Safe Indoor Environment

RESEARCH QUESTION

Can disinfectants be effective against replication-competent viruses on common surfaces?

SURFACE

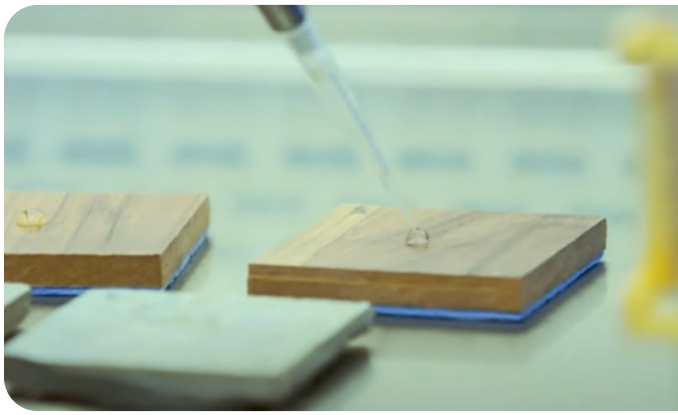
Screenshot from CBS This Morning Saturday on Sept. 5, 2020. Retrieved May 4, 2021, from https://www.youtube.com/watch?v=DXDRV-JwqBM.

AIM OF STUDY

Determine the effectiveness of two disinfectants in eliminating a SARS-CoV-2 surrogate (vesicular stomatitis virus) on three common surfaces.

STUDY METHODS

We assessed the efficacy of two disinfectants against a replication-competent SARS-CoV-2 surrogate virus on common surfaces: stainless steel, laminate wood, and porcelain.



Screenshot from CBS This Morning Saturday on Sept. 5, 2020. Retrieved May 4, 2021, from https://www.youtube.com/watch?v=DXDRV-JwqBM.

RESULTS

Both disinfectants produced a ≥3.23-log10 (>99.9%) reduction in the number of infectious particles, with all trials showing no viable, replication-competent virus on any surface post-disinfection.

RESEARCH TEAM

WELL LIVING LAB
Zachary Pope, PhD, Lead Scientist

MAYO CLINIC, DIVISION OF INFECTIOUS DISEASES
Stacey Rizza, MD, Professor of Medicine
Aditya Shah, MD, Assistant Professor of Medicine

MAYO CLINIC, DEPARTMENT OF MOLECULAR MEDICINE
Richard Vile, PhD, Professor of Immunology
Hideki Ebihara, PhD, Associate Professor of Molecular Medicine

RESEARCH PROGRAM
COVID-19 & Beyond: Safe Indoor Environment

BEHAVIOR

RESEARCH QUESTION

How are employees managing psychosocially during the COVID-19 pandemic, and are prevention behaviors being followed in the workplace?

AIM OF STUDY

Using an online survey, determine the impact of the COVID-19 pandemic on employees across multiple diverse workforce sectors.

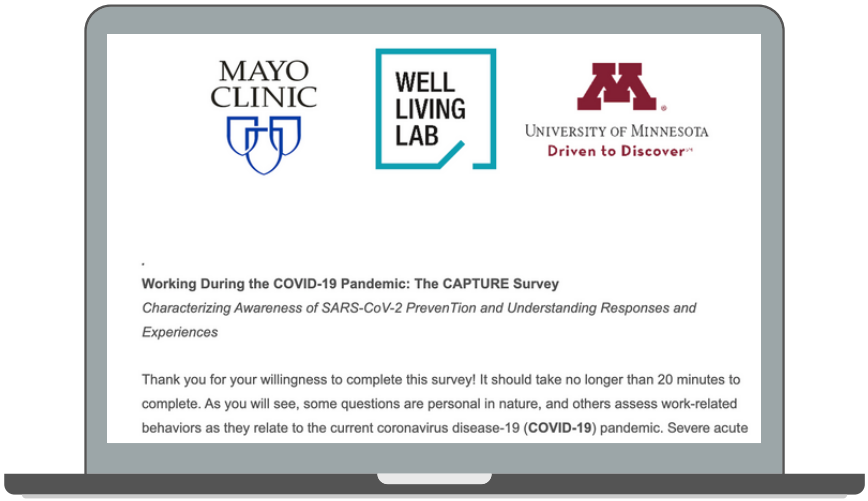
STUDY METHODS

We conducted an online survey of employees from diverse workforce sectors. Responses to the survey, entitled *Characterizing Awareness of SARS-CoV-2 PrevenTion and Understanding Responses and Experiences* (CAPTURE), were collected between November 20, 2020 and February 8, 2021.

RESULTS

Of the 3,607 employee responses, results suggested:

- >50% reported an increase in stress, anxiety, fatigue, and feeling unsafe;
- >60% reported a lack of companionship and being isolated while working;
- ~43% thought the COVID-19 pandemic had decreased their work productivity; and
- Most employees reported *often* or *always* wearing a mask, distancing, and washing hands regularly when at their company's workplace.



RESEARCH TEAM

WELL LIVING LAB
Zachary Pope, PhD, Lead Scientist

UNIVERSITY OF MINNESOTA, SCHOOL OF PUBLIC HEALTH, DIVISION OF EPIDEMIOLOGY AND COMMUNITY HEALTH
Mark Pereira, PhD, MPH, Professor, Epidemiology and Community Health

RESEARCH PROGRAM
COVID-19 & Beyond: Safe Indoor Environment

CONCLUSIONS

Air

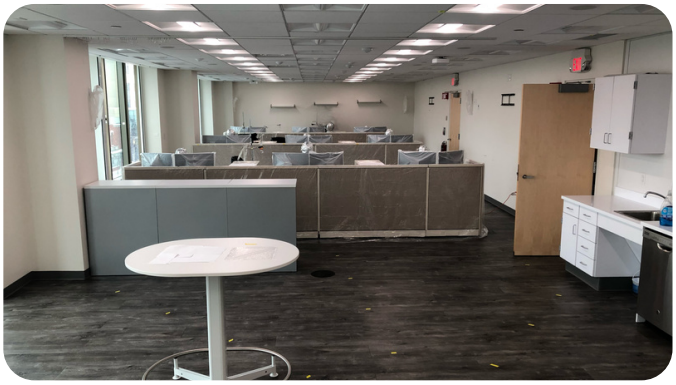
Ventilation and filtration impact airborne particle transmission indoors, but a room layout that promotes distancing is also critical. Mask wearing is always advised.

Surface

Using EPA-approved disinfectants per manufacturer instructions eliminates the presence, viability, and replication of replication-competent viruses on high-touch surfaces.

Behavior

Worsened psychosocial outcomes are present among most employees across several workforce sectors. Employees are being diligent about mask-wearing, distancing, and handwashing when at their company's workplace. The focus post-COVID-19 pandemic should likely be on improving employee psychosocial outcomes and continued advocacy for respiratory illness prevention behaviors.



NEXT STEPS

- Explore how air purification technology reduces airborne aerosol concentrations in classrooms and conference rooms.
- Pursue further surface disinfection research with a replication-competent strain of the SARS-CoV-2 virus.
- Continue our COVID-19 & Beyond work through field studies in senior living and school classroom environments.
- Complete the 3-month, 6-month, and 1-year follow-up CAPTURE survey deployments with individuals who completed the baseline CAPTURE survey.

RESEARCH PROGRAM
Residential Indoor Air Quality

$5B and growing

ANNUAL MEDICAL EXPENSES IN U.S. ASSOCIATED WITH INDOOR AIR EXPOSURE

RESEARCH QUESTION

How do particles produced during cooking impact human health? What mitigation strategies best reduce harmful exposure to occupants?

AIM OF STUDY

Understand whether particles generated during cooking create measurable acute health effects.

RESEARCH TEAM

WELL LIVING LAB

Jovan Pantelic, PhD, Lead Scientist

BACKGROUND

Particles generated during cooking spread throughout residential environments, exposing occupants and impacting health, performance, and perception of the environment. Mitigation of cooking-generated particles should be one of the design features in healthy homes.

RESULTS

Based on early results, we have observed that:

- Airflow patterns disperse cooking-generated particles (PM2.5) quickly across residential spaces;
- Stove hoods can effectively reduce emissions during cooking; and
- Portable air purifiers - when properly sized - are very effective in removing cooking-generated particles (PM2.5) from the air.

STUDY METHODS

We recruited 14 participants to live in the WLL residential modules for two weeks where they cook two meals per day. We continuously measure air quality (PM2.5) throughout the module. Participants measure their blood pressure and heart rate daily and have blood and urine samples taken three times per week to examine changes in biomarkers.

SPONSORED RESEARCH STUDY

*Environmental Protection Agency, 2018

RESEARCH PROGRAM
Advanced Research Projects Agency-Energy (ARPA-E)

Up to **40%** POTENTIAL ENERGY-SAVINGS WHEN USING OCCUPANCY DETECTION TO CONTROL HVAC*

RESEARCH QUESTION

What is the energy savings potential using occupant-centric HVAC control?

AIM OF STUDY

Quantify energy savings of Heating Ventilation and Air-Conditioning (HVAC) through a diversified eight-level protocol and a simulation suite to analyze the possible detection failures and potential energy savings of various types of occupancy sensors.

STUDY METHODS

The protocol and simulation suite was validated in controlled laboratory environments, as well as in four commercial buildings and four residential houses for field trial testing.

BACKGROUND

Occupant-centric building control (OBC) integrates actual building occupancy and comfort data with centralized building controls, engaging energy-related building services when and where they are needed by occupants. Occupant-centric control has a significant energy-saving potential (up to 40%) but needs to be confirmed by additional field studies.

RESULTS

- Four occupancy counting technologies - including a pressure-based sensor system, RFID sensor system, camera-based sensor system, and depth sensor system - were evaluated in the WLL office module. The averaged successful percentages of the four sensors are 82.5%, 41.8%, 69.5%, and 96.6% respectively.
- The energy-saving by OBC is highly related to the occupancy detection accuracy. 100% accuracy can guarantee around 30% energy saving in a mild climate. More than 35% energy might be saved in a cold or hot climate.
- The comfort level by OBC far exceeded 80% of ASHRAE criteria.

RESEARCH TEAM

WELL LIVING LAB

Rongpeng Zhang, PhD, Lead Scientist

EXTERNAL COLLABORATORS

U.S. Department of Energy; arpa·e Changing What's Possible; The University of Texas at Austin; Taylor Engineering; Syracuse University Founded AD 1870; Pacific Northwest National Laboratory

SPONSORED RESEARCH STUDY

*Applied Energy,, 2019

2020

WELL LIVING LAB™

STRATEGIC GOAL UPDATES

ACCELERATE WITH TECHNOLOGY
CATALYZE INNOVATION
SHARE THE VOICE

TECHNOLOGY + RESEARCH
From the Lab to the Field

In 2020, the WLL continued to solidify our technology platform, create new capabilities, and make significant progress in our artificial intelligence and machine learning (AI/ML) journey, enhancing our ability to generate practical insights.

KEY ACCOMPLISHMENTS

FIELD STUDY PLATFORM

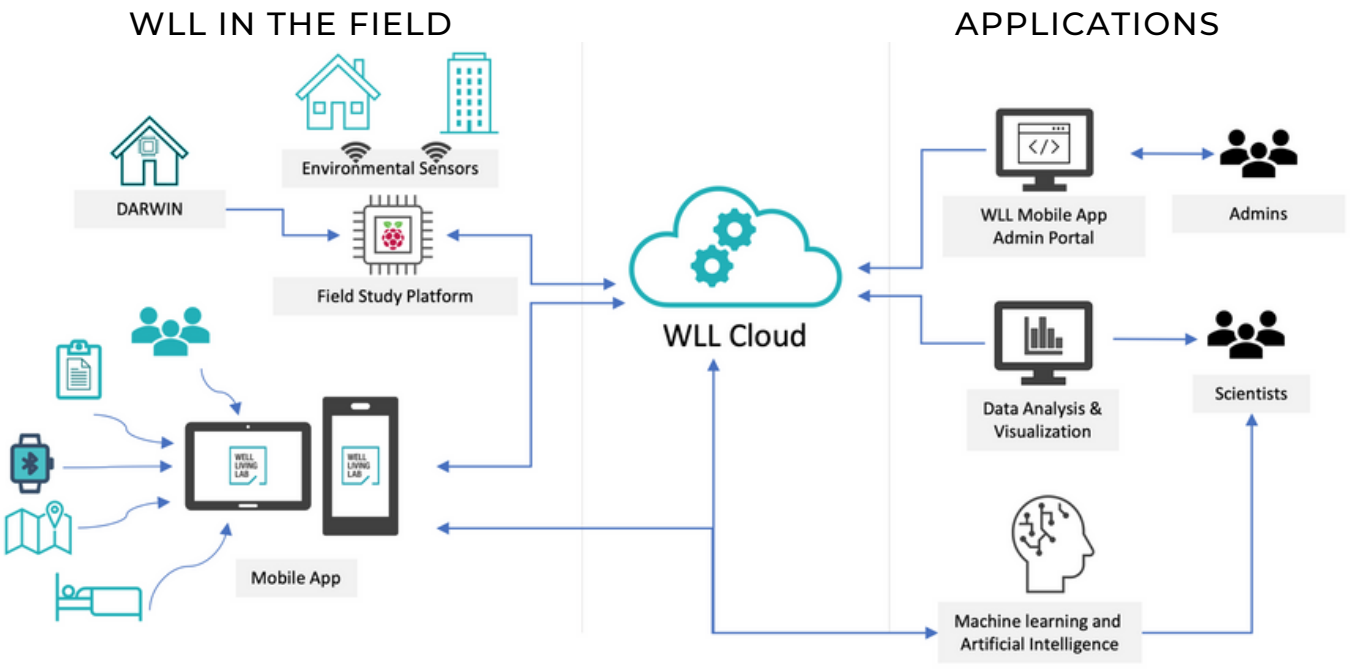
The WLL technology team enhanced our field study platform to be more flexible and adaptable, allowing us to better leverage its capabilities both in the lab and in the field. Improvements included:

EASY INTEGRATION

We expanded our field study platform by integrating with Delos's technology platform. This allowed us to broaden our ecosystem and easily integrate our technology with consumer smart home devices. The field study platform was showcased as part of the Well Living Lab's Healthy Home Program, launched in 2020.

MOBILE APP

We added a new mobile application to our technology toolkit, allowing better interaction with study participants and improving their compliance during studies.



TECHNOLOGY + RESEARCH
From the Lab to the Field

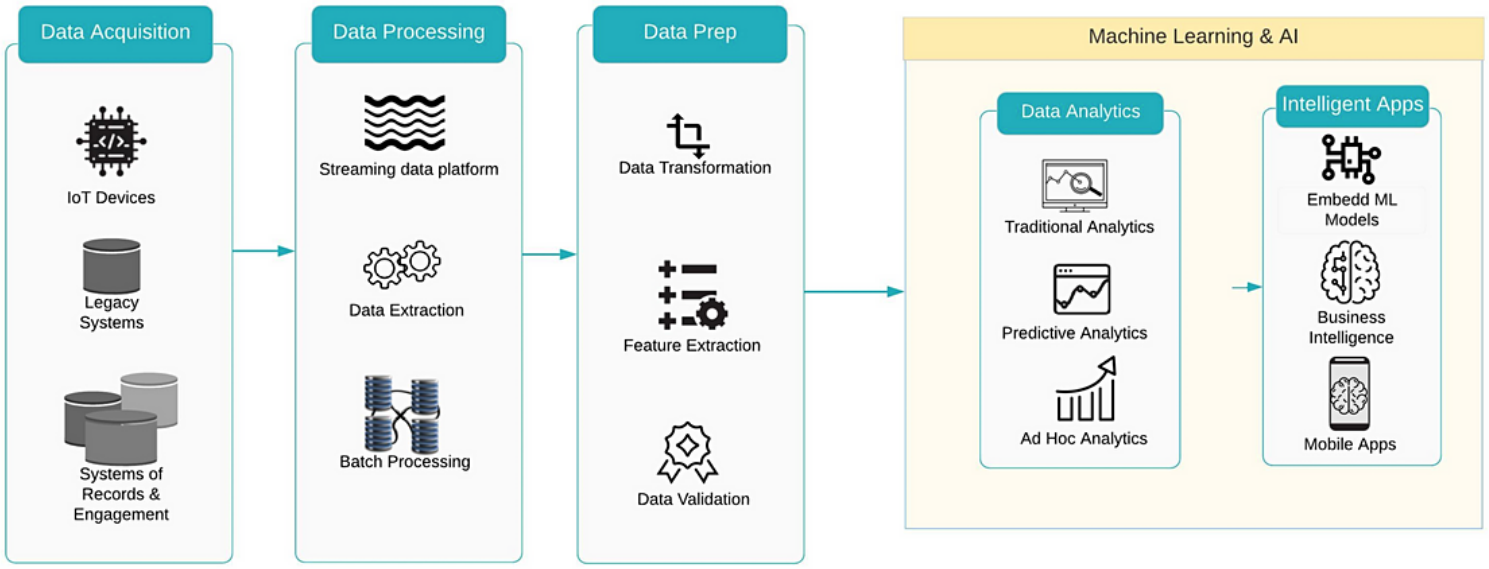
KEY ACCOMPLISHMENTS (CONT'D)

RESEARCH DATA MANAGEMENT ECOSYSTEM

The WLL's research data management ecosystem provides our researchers and technologies with capabilities such as data collection processing and advanced analytics and machine learning.

WHITE PAPER PUBLICATIONS

As we built this ecosystem, we published a paper, "Preparing and Architecting for Machine Learning," to share data reference architecture insights, experiences, and best practices. We also published a paper reviewing our learnings while using the Google Cloud natural language processing tool. These papers can be found on the WLL website under Technology.



NEW TECH TOOLS

Several new capabilities were added to our technology portfolio over the past year:

REAL-TIME LOCATION TRACKING

Real-Time Location Tracking System allows us to monitor the actual location of participants within the lab and improves our accuracy in tracking exposure to our interventions.

ADVANCED IOT AUTOMATION

With new advanced IoT automation installed in the WLL's residential modules, we can provide automated control, thereby keeping indoor air at a healthy level at all times without any human intervention.

STRENGTHENING THE MOVEMENT

Over the past year, we continued to position the WLL as a platform for innovation. We have grown and nurtured our strategic collaborations across the health and building ecosystem to impact people's lives where they live, work, learn, and play.

KEY ACCOMPLISHMENTS

COLLABORATIONS + PARTNERSHIPS

The Well Living Lab's mission is to transform human health and well-being in the indoor environment. We employ Discovery | Translation | Application as our research framework. Without collaboration and partnership, it would be impossible to realize these resolutions. True partnership is about identifying shared value and leveraging combined strengths to achieve an impact that could not be accomplished independently.

THE ALLIANCE

The breadth and depth of the Well Living Lab Alliance have expanded over the past year, bringing together industries such as technology, health and health care, wellness, hospitality, senior living, foundations, builders, transportation, and more.

Intentional collaborations with Alliance members, such as Healthy Home and Healthy Aging as highlighted on the following page, have strengthened our framework of Discovery | Translation | Application by moving our research from the Lab into the field where we can apply insights more quickly for personal and community benefit.

2020 & CURRENT MEMBERS

UNIVERSITY OF MINNESOTA

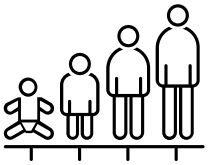
Earlier this year, we were pleased to announce an expansion of our collaborative model with our first academic partnership with the University of Minnesota, one of the most prestigious public research universities in the nation. We share the U's synergistic mission centered on discovery, seeking new knowledge that can change how we work and live.

As noted in our research summaries, we have been working closely with scientists from the U of M's School of Public Health and Department of Mechanical Engineering, with more relationships to unfold.

STRENGTHENING THE MOVEMENT

KEY ACCOMPLISHMENTS (CONT'D)

HEALTHY AGING WORKSHOP



We hosted a workshop in partnership with the Mayo Clinic Kogod Center on Aging during which we reviewed health, behavioral, and indoor environmental factors that limit functional independence among the aging population. Together, we identified research opportunities aimed at improving the interaction between humans and indoor environments to improve health and promote independence in older adults.

Planning is underway to design studies to be conducted in senior living communities, enabled by the WLL's field study platform – we anticipate launching the studies in late 2021.

HEALTHY HOME WORKSHOP

We also hosted a Healthy Home workshop in partnership with WLL Alliance organizations. We intend to extend our research into the real-world home environment in a test home to accelerate the application of WLL interventions and discoveries to positively impact individual and family well-being, creating a healthier home and ultimately, a healthier community.

Key features of the test home will include the ability to conduct human-centered research, use of best-in-class technology (adaptable, reconfigurable, sensor-rich, and IoT-enabled environment, connected to the main lab via the WLL's field study platform), and incorporating a collaborative hub model for academia and industry.

Planning is underway to develop the test home model and research agenda with a launch in 2022.

BUILDING AWARENESS & ENGAGEMENT

The past year introduced a variety of new and creative opportunities for us to continue building awareness of the Well Living Lab and strengthening our scientific voice around the world.

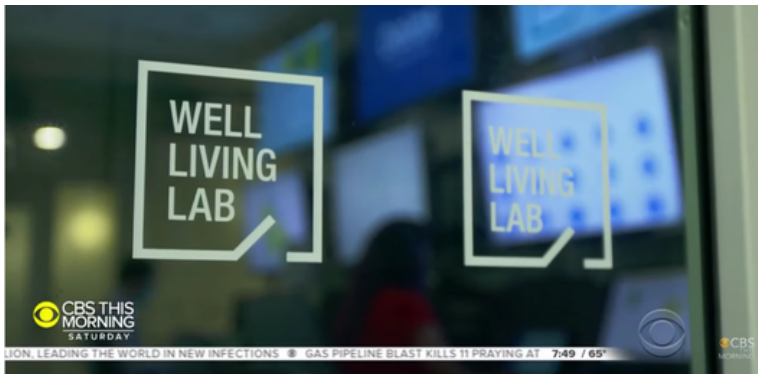
KEY ACCOMPLISHMENTS

NATIONAL MEDIA COVERAGE

The Well Living Lab saw an increase in national media coverage during 2020 with the most notable highlight being a feature on CBS This Morning about a safe return to offices in a post-COVID era.

Additional national coverage:

- Forbes
- The New York Times
- Infection Control Today
- Builder Magazine
- Construction Week Online
- CE Pro
- The Real Deal



Screenshot from CBS This Morning Saturday on Sept. 5, 2020. Retrieved May 4, 2021, from https://www.youtube.com/watch?v=DXDRV-JwqBM.

SOCIAL & DIGITAL IMPROVEMENTS

As COVID abruptly halted in-person engagement in 2020, we welcomed the opportunity to enhance and strengthen our digital platforms.

WEBSITE REDESIGN

The Lab's tech and communication teams united to not only redesign the WLL website for a better user experience but also to incorporate some much-needed COVID-19 resources and study updates.

SOCIAL MEDIA ANALYSIS & ENGAGEMENT

We expanded our social reach and engagement across platforms with visitors from more than 30 countries and nearly every state.

ALLIANCE ENGAGEMENT: SUMMIT, WEBINARS, NEWSLETTERS

- Nearly 90 individuals from 20+ Alliance member organizations attended the 5th Annual Well Living Lab Alliance Summit + Showcase held virtually on October 6, 2020.
- Four quarterly webinars featured subject matter experts from the WLL, Mayo Clinic, and the University of Minnesota on topics such as sleep and COVID-19.
- Redesigned quarterly newsletters with updates from across the WLL kept Alliance members abreast of the continued studies happening in the Lab and in the field.

2021
& BEYOND

WELL LIVING LAB™

ADVANCE THE SCIENCE

UPCOMING AND IN PROGRESS RESEARCH STUDIES

RESEARCH PROGRAM
Healthy Home

$30B PROJECTED VALUE OF THE SMART HOME HEALTHCARE INDUSTRY BY 2025*

RESEARCH QUESTION

What can homeowners do to ensure their families are living in a healthy home? What unanswered questions can be scientifically addressed to inform how we design and remodel homes?

AIM OF STUDY

Demonstrate how the home environment impacts physical health, mental health, and cognitive performance.

POSSIBLE IMPACT

A better understanding of how indoor environments mitigate adverse effects of stress and improve a person's mental and physical health and well-being.

RESEARCH TEAM

WELL LIVING LAB

Kevin Mazurek, PhD, Lead Scientist

EXTERNAL COLLABORATORS

Mayo Clinic

Alliance Members

- 3M
- Harrison Street
- Herman Miller
- KB Home
- Marvin
- Noaber
- Panasonic
- Withings

BACKGROUND

The Healthy Home Program, launched in February 2021, is focused on accelerating new discoveries from the Well Living Lab research laboratory to the real world. This program is an important step toward broadening public availability of beneficial learnings about the impact our home environments have on health, sleep, stress, resiliency, comfort, and performance.

1 MODEL HOME - LAUNCHED

2 TEST HOME - IN PLANNING

3 COMMUNITY HOMES - IN PLANNING

NEXT STEPS

We are in the planning stages of the test home and developing the research framework and the collaborations necessary to design, build, and launch the second phase of the Healthy Home program.

*Global Market Insights, 2018

RESEARCH PROGRAM
Clinician Burnout Incorporating MindBreaks

$4.6B ANNUAL COST OF PHYSICIAN BURNOUT TO THE MEDICAL INDUSTRY*

RESEARCH QUESTION

Can perceived stress and burnout be reduced and job satisfaction be improved when employees use relaxation spaces that incorporate elements of nature to promote calmness?

AIM OF STUDY

Understand if indoor environments can:

- Improve post-stress recovery;
- Reduce clinician burnout; and
- Improve emotional and mental well-being.

POSSIBLE IMPACT

A better understanding of how to design indoor environments to mitigate adverse effects of stress and improve a person's mental and physical health and well-being.

RESEARCH TEAM

WELL LIVING LAB
Kevin Mazurek, PhD, Lead Scientist

MAYO CLINIC, DEPARTMENT OF INTERNAL MEDICINE
Liselotte (Lotte) Dyrbye, MD, Professor of Medical Education & Medicine
Colin West, MD, PhD, Professor of Medical Education, Medicine, & Biostatistics

BACKGROUND

Burnout amongst physicians can have adverse consequences on quality and safety, patient-physician relationships, productivity, and physician turnover.

Previous WLL studies have demonstrated that exposure to biophilia can improve performance and job satisfaction. These same elements are incorporated in MindBreaks rooms to understand how physiological, cognitive, and emotional well-being change after acute or chronic stress.

NEXT STEPS

We are conducting two studies on how individuals recover after stress and whether techniques, such as using a MindBreaks room, might be an effective intervention to mitigate the adverse effects of stress and improve mental health and well-being.

One study will focus on understanding how physiological measures and cognitive performance change after acute stress and whether different sensory features of the MindBreaks room help promote recovery after stress. A second longitudinal study will focus on whether Mayo Clinic clinicians who regularly use a MindBreaks room have improvements in self-report of burnout, job satisfaction, and emotional well-being.

Successful completion of these studies could lead to a better understanding of how to design indoor environments that can mitigate the adverse effects of stress and improve an individual's mental and physical health and well-being.

*Healthcare Dive, 2019

“The aim of medicine is to prevent disease and prolong life, the ideal of medicine is to eliminate the need of a physician.”

- Dr. William J. Mayo,
National Education Association:
Proceedings and Addresses, 1928

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