

PULSE ON PROGRESS

Proceedings of the inaugural meeting of the
AIA Design & Health Research Consortium

Princeton, New Jersey

March 5, 2015



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**Prepared by The American Institute of Architects, the Association of Collegiate
Schools of Architecture and Architects Foundation.**

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Table of contents

1. Executive summary	1
2. Context	10
3. Proceedings & observations	14
4. Conclusion	32

1. **Executive summary**

Overview

In March of 2015, the American Institute of Architects convened the inaugural cohort of the AIA Design & Health Research Consortium. The Consortium is a collaboration among AIA, the Association of Collegiate Schools of Architecture, Architects Foundation and the Association of Schools and Programs of Public Health. The mission of the Consortium is **to pursue, acquire and disseminate knowledge at the intersection of design and health disciplines.** To join the Consortium, schools and programs of architecture and public health were required to respond to a competitive request for qualifications.

Applications required:

- Interdisciplinary teams, including co-Principal Investigators from health and design;
- A demonstrated body of funded research;
- Partnerships with third-party organizations including other universities, firms, community design centers, public health institutions and government agencies; and
- Close alignment with AIA's six areas of focus: environmental quality, natural systems, physical activity, safety, sensory environments and social connectedness.

Teams were selected by a jury of peers, including representatives from the Association of Schools and Programs of Public Health (ASPPH) and the Association of Collegiate Schools of Architecture (ACSA).

Hosted in Princeton, New Jersey, with the Robert Wood Johnson Foundation (RWJF), participants represented the following universities:

- Columbia University
- Drexel University
- NewSchool of Architecture & Design, IDS, and University of California, San Diego
- Texas A&M University
- Texas Tech University
- University of Arizona
- University of Florida
- University of Illinois at Urbana-Champaign
- University of Kansas
- University of Miami
- University of Oregon

Event structure

Through this inaugural convening, AIA and its partners sought to capitalize on the foundation of interdisciplinary research and collaboration and focused the meeting on knowledge sharing, relationship building and early priority setting. This distinguished and diverse set of institutions had not previously worked together on this scale, yet the results were illuminating. The four specific goal areas and intended outcomes for the meeting were:



Matthew Trowbridge, MD, University of Virginia School of Medicine, chats with Joan Barlow of the Robert Wood Johnson Foundation, at the first annual convening of the AIA's Research Consortium on Design & Health.

SOURCE: John Schneidawind

- **Networking.** The AIA is committed to providing ample opportunity for teams to network within and between themselves. At the end of the meeting, representatives should have a plan for active collaboration throughout the three-year period of support. This network will provide a venue to test ideas, seek solutions and reduce redundancy in the literature.
- **Inspiration.** AIA has identified six approaches (page 11) to achieving health through built environment design and policy. These six approaches resonate with the designers who are responsible for physically manifesting the intents of the health community. At the end of the meeting, representatives from both health and design should be able to speak about their work using these approaches.
- **Innovation.** AIA acknowledges the constantly evolving technological, political and ecological landscapes affecting the health—and physical design—of the nation. At the end of the meeting,

representatives will be primed to understand, translate and address these issues through deep collaboration.

- **Problem solving.** AIA is committed to positioning the Consortium as a venue to share ideas and frankly discuss challenges in the research, evaluation, and design of a healthier nation. At the end of this meeting, representatives should leave confident in the strength of their peer network and feel prepared to generate resources to practitioners.

To achieve these ends, the meeting was designed in three main parts:

- **User sessions.** To capture the impact of current innovations and spur new thinking about the many points of intersection between design and health, a series of cross-sector users discussed how existing research is changing the market, and addressed some of the areas of investigation most relevant to their practice.

- **Table discussions.** To establish a set of priorities for the Consortium’s work moving forward, five one-on-one and small group dialogues were organized around common, critical issues related to research.
- **Consortium member presentations.** To help Consortium members become familiar with each other’s work, each school was asked to deliver a seven-minute, high-impact presentation that introduced the intent and idea behind their research while answering the question, “What are the most anticipated practice or policy implications of your research, and how might they improve the world?”

User sessions

Rachel MacCleery, Senior Vice President, Content, Urban Land Institute, shared the *Building Healthy Places Toolkit*, a new resource that leverages existing research to identify opportunities to enhance health through real estate decision making. The group discussed ways to connect real estate developers with Consortium members to improve the measurements of health outcomes at the project level.

Whitney Austin Gray, PhD, LEED AP, Executive Director of Research and Innovation, Delos, discussed the challenges associated with getting the owner and client to invest in the shared movement around health and well-being through design.

Sandra Whitehead, PhD, Director of Healthy Community Design, National Association of County & City Health Officials, shared how NACCHO and its members are embracing health impact assessments (HIAs) as a vehicle to apply research to practice. The group discussed opportunities to integrate HIA processes in the architectural studio curriculum as a means to expose students to health concepts.

Sarah Schaefer, US Department of Housing and Urban Development, offered examples of successful health-focused projects in Lehigh Valley, East New York,

Boston, Seattle and Denver’s Mariposa Community, to build a case for HUD’s interest in research connecting design and health. The group discussed opportunities to encourage greater federal funding for research that promotes sustainable and inclusive communities.

Table discussions

Attendees were asked to be prepared with real life successes and challenges to present to their pre-assigned groups in five table discussions.

CROSS-CUTTING THEMES

A major area of follow-up for the Consortium will be to define and discuss the ways in which the themes and opportunities from each table discussion can be built into a broader, integrated set of research priorities. For instance, it is clear that whatever advances we make in **Education** will help to drive the development of next-generation **Metrics** that can provide more actionable data on built environment health performance. The **Internet of Things, Resilience & Equity** and **Metrics** are inextricably linked to one another, as more granular data enables us to have a better understanding of the root causes of inequity, and to develop a system for measuring progress toward equality.

EDUCATION

Andrew Dannenberg, MD, MPH, and Hilary Sample, AIA, co-moderated a table discussion on transforming education through cross-disciplinary efforts.

Key themes that emerged

- There was consensus among the group that as awareness and understanding grows of the connection between design and health, there is an ever-increasing need to create a common culture among the disciplines.

- Creating the common culture will be challenging from the disciplinary perspective since designers, public health professionals and other leaders in this field each come with separate approaches and vocabularies, thus creating a challenge to work collaboratively.
- Additionally, the group identified five institutional barriers to increasing cross-disciplinary work, including **lack of funding**; the fact that there are **few existing models** to support interdisciplinary work; **limited perspective** on the role architects can play as health professionals beyond designing healthcare facilities; a lack of procedures surrounding **academic promotions** for this type of cross-disciplinary work; and an absence of **accreditation standards** for design and health programs.

Areas of opportunity

- Despite these barriers, numerous efforts are underway across sectors to create a common design and health culture. For instance, agencies and groups including the Centers for Disease Control and Prevention, Active Living Research and the Urban Land Institute are actively participating in research linking design and health. Furthermore, an increasing number of universities and colleges are expanding their degree programs, courses and certificates to include interdisciplinary faculty.
- The group also discussed numerous ways to facilitate and accelerate a design and health cross-culture. Ideas included doing more to highlight best practices using digital platforms; more forcefully advocating for cross-curricular courses in the academy; developing design and health internships; encouraging diverse and frequent publishing; and leverage existing conferences to promote cross-cultural exchange.

METRICS

Matthew J. Trowbridge, MD, led a discussion on how the unique structure of the Consortium—which requires integrated design and health research teams—can overcome perceived disciplinary barriers and empower individuals through the use of common metrics. Furthermore, the group discussed the role of metrics in changing business and service models.

Key themes that emerged

- Architecture and public health are both professions that are familiar and comfortable working within established performance metrics. However, those metrics tend to measure different types of things on different geographic and time scales.
- Current typical health metrics—such as rates of obesity or heart disease trends over a broad geographic area, like zip code, and a long timespan—are not readily applicable to building performance. For the data to be actionable for architects, it must be applicable at the street address level and over a shorter time period.
- Promising developments in this area have been made with applications and websites that leverage and aggregate available data, but they are still in their formative stages.

Areas of opportunity

- The group discussed three specific strategies to focus on while developing the next generation of built environment health performance metrics:
 1. **Improve ease of surveillance methods.** Current health surveillance systems are time and resource intensive. This could possibly be ameliorated through greater use of mobile or technologies as well as cross-disciplinary data sharing.

2. **Supplement big data with field observation.** Big data may be able to tell you that building a school a half mile from a home encourages walkability. But that data point must be contextualized with information like whether there is a major intersection to cross in that half mile, or if there are sidewalks to walk along. As the quantity of data expands, qualitative complements to big data will become more critical to the complex relationship between behavior, health and place.
3. **Consider incorporating built environment health performance into contracts.** The AIA, whose contract documents are the industry standard, has a unique opportunity to shape this conversation and educate the profession.

- A greater limitation at this point, however, is in the research and funding for transforming the massive amounts of data these devices can collect and share into practical applications that can inform everyday decisions on improving health through design.

Areas of opportunity

- The group agreed that while there is a critical need to find resources to advance this work, growing client demand for better health outcomes and their subsequent lower societal costs will ultimately drive funding of translational research.
- The group also agreed that while architects are skilled at integrating disparate data sets into complex projects, they are less able to use and conduct foundational research. To bridge this gap, the group envisioned that standard-setting organizations such as ANSI, GSA and USGBC will ultimately play a role in driving both a culture of research-based decision making, and the integration of health outcomes research into design software that architects already use.

“INTERNET OF THINGS”

Thomas Fisher, Assoc. AIA, led a discussion of how modern devices, tools, and trackers can enable greater connections between design and the built environment.

Key themes that emerged

- The “Internet of Things” was loosely defined by the group as anything with a URL or IP address, and the discussion focused primarily on the relationship between the data gathered by wearable technology and the systems that the data is—or could be—fed into. The interconnectivity made possible by the Internet of Things has had meaningful positive impacts on human health and safety through advances such as self-monitoring systems, Life Alert and accident reporting devices.
- These advances come with significant limitations, especially in terms of scale of data recorded, and access of these devices and their related apps among the general population.

RESILIENCE AND EQUITY

Co-moderators Victor Rubin, MCP, PhD, and Lynne M. Dearborn, PhD, led a discussion on the often unacknowledged impact of inequitable distribution of conditions that lead to sickness, poor health and reduced quality of life.

Key themes that emerged

- More and more health prevention and treatment focuses on changing unhealthy conditions to healthy ones. For instance, part of the treatment for a child with asthma may be to improve air quality to reduce triggers. However, access to these types of implementations are far from universal.

- Research has documented that members of racial and ethnic minorities disproportionately suffer from environmentally-linked disease, chronic health conditions, reduced life expectancy and reduced general well-being.
- The question of resiliency, whether at the individual or community scale, is therefore implicitly linked to questions of equity and exposure to harmful and unhealthy environments. As such, resilience in the context of health and environment must engage questions of race, ethnicity, income and institutionalized prejudice.
- Equitable access to healthful environments should be a community-based, not a strictly client-based, concern. As leaders in the design process, architects should understand that equity is not just about physical access to healthy built environments; it's also about design processes that facilitate the social equity that make that access possible.

Areas of opportunity

- A shift could be made to re-envision resilience in environmental design as a series of preventive strategies that support community participation in the design process as well as resultant environments that promote health, encourage healthy activities and enable recovery.
- A process for promoting greater equity—and for defining the necessary research agenda and policy solutions to achieve it—can begin by understanding and defining the issues through three key questions:
 1. What are the possible ways to measure inequality and equity?
 2. How should resilience be defined in the context of environmental equity?
 3. Once defined, how can it be effectively and appropriately measured?

TRANSLATION

Co-moderators Whitney Austin Gray, PhD, LEED AP, and Joanna L. Lombard, RA, LEED AP, led a discussion intended to acknowledge successes and propose solutions for accelerating a national movement based on useful translation of research connecting design and health.

Key themes that emerged












- The group identified numerous significant milestones over the past decade in quantifying and supporting further research regarding the impacts of the built environment on public health. One specific example raised was the *Patient Protection and Affordable Care Act* of 2010 requirement for charitable hospitals to provide community health needs assessments, thereby creating new incentives to develop new measurement processes and toolkits.
- These efforts have had real and significant impacts, including the development of the *Active Design Guidelines*, the establishment of the Evidence-based Design Accreditation and Certification Program, and the formation of the Consortium itself.

Areas of opportunity

- Based on the growing and converging awareness of the health impacts of the built environment, numerous opportunities exist to generate action and build capacity. Three potential strategies include the **use of individual narratives** as a portal to learning; expansion and broader **application of community-based research**; and an increased **use of participatory planning and assessments**.
- In the realm of education, areas of opportunity include an expansion of interdisciplinary programs in response to the 2005 call from the Institute of Medicine; creating an architecture-public health practicum for students; and establishing collaborative education credits that could be used across professions.

Member presentations

Consortium members' presentations spanned a wide spectrum of research, projects and initiatives that are changing the way architects, planners, clinicians and public health professionals conceptualize design and health. This document organizes members' presentations by AIA's six approaches to emphasize connections among members.

Six approaches		Columbia University	Drexel University	NewSchool of Architecture & Design, IDS, and University of California, San Diego	Texas A&M University	Texas Tech University	University of Arizona	University of Florida	University of Illinois at Urbana-Champaign	University of Kansas	University of Miami	University of Oregon
 Environmental quality				●	●	●	●	●	●	●		●
 Natural systems			●	●	●	●	●		●	●	●	●
 Physical activity		●	●	●	●	●		●	●	●	●	
 Safety				●	●	●	●	●		●		
 Sensory environments			●	●	●	●	●	●		●		
 Social connectedness		●	●	●	●	●		●	●	●	●	
Table discussions												
 Education		●	●	●			●					
 Metrics				●					●	●	●	●
 "Internet of Things"		●			●	●	●	●				
 Resilience & equity			●			●			●	●	●	
 Translation		●	●		●			●			●	●

● Featured in report ● Included in research ● Participated in table discussion

AIA FOCUS AREA	MEMBER RESEARCH AND DISCUSSION
Environmental Quality	University of Oregon shared promising research about potential co-benefits of natural design strategies to enhance energy efficiency: occupants may have enhanced immune systems and reduced instances of asthma and allergies.
	University of Florida is working to develop sensors that can provide nearly real-time, consumer-friendly information about indoor pollutants emitting from smoke- and flame-retardant materials, as well as track that information over time and across occupants in rental units.
	University of Illinois at Champaign-Urbana noted that although traffic pollution is a known asthma trigger, urban zoning policies frequently situate vulnerable populations near highways.
	Texas Tech University shared that concerns over environmental pollutants are not unique to city dwellers. Rural residents must, for instance, have to contend with such issues as agricultural waste and arsenic in water supplies.
Natural Systems	University of Illinois at Champaign-Urbana reported on a collaboration with community partners to develop and test evidence-based strategies that promote restorative environments as a means to reduce stress, especially in smaller cities.
	University of Miami shared updates from a three-year joint project with the Miami-Dade County Parks, Recreation and Open Spaces department to test the impact of adding greenery to parks in low- and middle-income neighborhoods.
	University of Kansas has shown progress in addressing health inequalities stemming from lack of access to healthy environments and grocery stores in low-income communities in an innovative, cost-effective way: siting public transportation stops within a half-mile of existing food outlets and green spaces.
Physical Activity	Since 1983, the Texas A&M University's Center for Health Systems and Design has been pioneering translation and evaluation efforts to move active-living and community-design research into practice and policy.
	Drexel University reported on two case studies where supplementing good design with community engagement increased physical activity; one in a low-income housing complex and the other in a school.
	Texas Tech University's team is investigating strategies to increase lifespan and well-being in the absence of dense population clusters; the lack of density is a known barrier to creating designs in the built environment that promote physical activity.
	University of Miami discussed research showing that zoning restrictions that limit development in relatively homogeneous immigrant communities create barrier to physical activity. In a related study, the team was able to positively associate living in mixed-use neighborhoods in Miami with improved academic performance.
	Columbia University reported on an epidemiological study of the role of urban form and design in promoting physical activity in New York City. They subsequently outlined the challenges faced in conducting similar research in the densely populated Rio Das Pedras favela in Brazil. The inability to effectively measure the impact of dense, chaotic unplanned systems significantly diminishes the ability to develop design or policy solutions.

AIA FOCUS AREA	MEMBER RESEARCH AND DISCUSSION
Safety	University of Arizona discussed a unique device it is testing called Smart Sox. Smart Sox use sensors and fiber optic cables to improve the quality of life of diabetics by monitoring temperature, pressure and stress before ulcers have the opportunity to form.
Sensory Environments	<p>University of Florida juxtaposed existing policy and design guidelines with known health outcomes for vulnerable populations to prompt a dialogue around the potential of design and building standards to advance health.</p> <p>The NewSchool for Architecture and Design team has established a “Sensorium” to provide a venue to evaluate the neurological impact of architecture through built environment simulations. Using this tool, the team is able to predict human responses to design strategies affecting movement & memory, light & location, and natural systems.</p> <p>University of Arizona presented multiple environments designed to evaluate the effectiveness of evidence-based design strategies to reduce stress and promote well-being of residents.</p>
Social Connectedness	<p>Columbia University’s project in the Rio Das Pedras favela lays the groundwork to improve health and to overcome intense, unregulated poverty.</p> <p>University of Florida shines its light on the unique physical, mental and emotional needs of aging populations.</p> <p>Texas A&M University leveraged improvements in walkability to increase social interaction among neighbors.</p> <p>University of Kansas is forging alternate healthcare models in which a range of environmental, cultural and socioeconomic factors can change the fundamental way in which communities connect and thrive.</p> <p>Texas Tech University and University of Illinois teams are studying the human cost of a reduced sense of community in low-density population areas and found, for example, that young people’s suicide rates are nearly two times higher in rural communities.</p> <p>Drexel University hopes to improve the health and economic opportunities in an area with deep and persistent poverty by involving community members in rehabilitation efforts. The target is Mantua, a low-wealth neighborhood of West Philadelphia in a two-square mile designated Promise Zone.</p>

2. Context

A rationale and goals for the Design & Health Consortium

The AIA with ACSA, Architects Foundation, and ASPPH established the Design & Health Research Consortium **to pursue, acquire and disseminate knowledge at the intersection of design and health disciplines.**

Although much research, largely funded by RWJF's Active Living Research program, exists to connect community design and rates of obesity, the work is only beginning to be institutionalized within design firms. Other areas of investigation, especially those exploring mental and social health issues, are even more nascent.

One goal of convening members of the AIA Design & Health Research Consortium was to share and inspire translatable research with a wide range of professionals. This document synthesizes key ideas expressed during the meeting in Princeton.

Criteria for selection of teams for the AIA Design & Health Research Consortium

The cross-disciplinary university teams selected to be members of the inaugural cohort of the AIA Design & Health Research Consortium represent a mix of research scope and scale, professional disciplines, geographic regions, university sizes, and readiness to conduct and translate research. A Request for Qualifications was distributed to schools and programs of public health and architecture in late 2014. From the eligible responses, 11 university Members were selected by a jury of peers, including representatives from ACSA and ASPPH.

Approximately 60 individuals representing a diverse set of perspectives and professional interests were invited to participate in the Princeton convening. University teams were invited to send up to three individuals, including a design investigator and health investigator at a minimum. University teams were joined by the 14-person multi-discipline AIA Design &

Health Leadership Group, staff and invited guests from government and non-government organizations.

Collectively, the attendees represented a mix of voices deeply entrenched in built environment issues, such as architects and planners, and others who are newer to the conversation, such as kinesiologists. The attendees further represented diversity in terms of age, sector and experience working at the intersection of design and health.

Six approaches to health through the built environment design and policy

The diverse composition of the Consortium underscores the need to establish common definitions and approaches to improving health outcomes through design. Teams have organized their work around six common approaches to the shared goal: communities that offer the same opportunity for a long, healthy life regardless of their income, education, or ethnic background. Specific tactics, applications and evaluation of the common approaches may change depending on a researcher's professional background—for example, a clinical care provider will bring a different context and perspective than a public health official or an architect.

The six approaches to health through built environment design and policy, as advanced by the AIA, are:

- **Environmental quality**, in the context of design and health, refers to preventing, mitigating or reversing quantifiable chemical and microbial site, water and air pollutants that directly or indirectly affect populations. Environmental quality is a public health priority because chemical exposure can inhibit neurological function, increase rates of cancer and increase incidence of low-birth weights; untreated water increases the likelihood of waterborne illness, especially among vulnerable populations; and air pollutants contribute to increased mortality and morbidity from cardiovascular and respiratory disease, as well as to climate change.



As Consortium teams worked to soften the lines of language and frames of reference that too often define and delineate areas of professional interest, the New Jersey landscape was quietly reshaped by 8” of snow.

SOURCE: Joanna Lombard, RA, LEED AP

- **Natural systems** refer to natural forms, diverse species and ecosystems that influence design. The promotion of natural systems is a public health priority because it provides stress relief, accelerates recuperation times, advances healthy eating, promotes physical activity and encourages social activity. More than that, natural systems provide shelter, filtration, crop vigor, and climate control.
- **Physical activity** refers to exercise, recreational activity and activities that comprise everyday life, including labor, commuting and chores. Physical activity is a public health priority because it promotes individual choices and habits that reduce the risk of cardiovascular disease and other health problems.
- **Safety** refers to the protection from physical or psychological harm caused by accidental injury or crime. The promotion of safety is a public health priority because it removes both real and perceived impediments and disincentives influencing physical activity; it reduces the likelihood of physical injury; and it helps alleviate and reduce anxiety and stress that can increase the likelihood of hypertension, hyperglycemia and obesity.
- **Sensory environments** refer to the perceived olfactory, tactile, acoustic and aesthetic quality of space that contributes to the physical, mental and emotional well-being of people. Diverse sensory environments are a public health priority because they promote safety, well-being and quality of life.
- **Social connectedness**—also referred to as “social capital”—refers to the networks of relationships that bind people together. It includes attitudes and norms such as trust and reciprocity, as well as behaviors such as civic participation, voting and helping neighbors. Social connectedness is a public health priority because it helps communities and societies function more effectively, predicts higher levels of happiness and well-being, and predicts better health.

Event agenda

Winter Storm Thor was a widespread winter storm that affected much of the United States for three days, March 3-5, 2015. The storm caused the closure of the intended venue and rerouted several attendees' flights, yet all of the Consortium teams were represented in Princeton. Constrained by available space at an alternate venue, the snow day agenda emphasized leisurely networking and smaller working groups to achieve the event goals of networking, inspiration, innovation and problem solving.

- **Welcoming remarks** by AIA and RWJF staff and volunteer leadership describing objectives for the AIA Design & Health Research Consortium convening.
- **Table discussions** facilitated by committee members establishing priorities for the Consortium moving forward related to common issues among research teams. The five breakout sessions were:
 1. Education
 2. Metrics
 3. "Internet of things"
 4. Resilience & equity
 5. Translation
- **User sessions** capturing the impact of current innovations in design and health research. Government and non-governmental nonprofit organizations discussed how existing research is changing the market and some of the areas of investigation most relevant to their practice.
- **Consortium member presentations** familiarizing Consortium members with each other's work. Schools asked to answer the question, "What are the most anticipated practice or policy implications of your research, and how might they improve the world?"
- **Closing remarks** including summary of the key takeaways.

DESIGN & HEALTH LEADERSHIP GROUP

Chair

Daniel S. Friedman, FAIA, PhD

Members

Andrew Dannenberg, MD, MPH
R. Denise Everson, Assoc. AIA, LEED AP
Thomas Fisher, Assoc. AIA
Howard Frumkin, MD, MPH, DrPH
Whitney Austin Gray, PhD, LEED AP
Ernest W. Hutton, Jr., Assoc. AIA, FAICP
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Ray Pentecost III, FAIA, DrPH, ACHA, LEED AP
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Esther Sternberg, MD
Matthew Trowbridge, MD

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Research Working Group Members

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Upali Nanda, PhD, Assoc. AIA, EDAC
Annette Olson, PhD

ACSA

Michael Monti, PhD

Architects Foundation

Sherry-Lea Bloodworth Botop

ASPPH

Rita Kelliher, MSPH
Sarah Weiner

3. Proceedings & observations

Welcoming remarks

Inspired by the snowfall rapidly reshaping the landscape of Princeton, New Jersey, in March 2015, members of the inaugural cohort of the AIA Design & Health Research Consortium worked to soften the lines of language and frames of reference that too often define and delineate areas of professional interest. Comprised of representatives from eleven university teams, the group addressed the initiative's mission: **to pursue, acquire and disseminate knowledge at the intersection of design and health disciplines.**

Daniel Friedman, PhD, FAIA, encouraged the group to explore what it means to merge adjacent but distinct professional vocabularies, such as public health and building design. To encourage a richer exchange, he suggested the temporary suspension of the typical assumptions about professional practice among the allied disciplines. He invited the group to quiet self-limiting remarks in the vein of "I don't know because I'm only an architect" or "Not being a designer..." and to deeply engage the expertise and experience of each member. In doing so, Daniel suggested, a new, common language may emerge.

In pursuit that goal, Suzanna Kelley, FAIA, LEED AP BD+C, encouraged the group to use the AIA's previously outlined [Six Approaches to Achieving Health through Built Environment Design and Policy](#) and RWJF's *Culture of Health* to anchor their discussions.

The effectiveness of using those documents as the framing mechanisms became crystalline toward the end of the day when representatives from each university team presented snapshots of their work. They revealed the range and variety of scales, topics and methodologies being undertaken by the diverse Consortium membership. Taken together, they confirmed the rapidly expanding research and growing implementation of policies and practices aimed at achieving health by improving environmental quality, natural systems, physical activity, safety, sensory environments and social connectedness.

Discussion breakouts

EDUCATION

Andrew Dannenberg, MD, MPH; Hilary Sample, AIA; and Eve Edelstein, M.Arch, PhD, Assoc. AIA, F-AAA

The research embodied in Consortium members' work reinforces how intertwined the built environment and its impact on human health are. Cross-disciplinary University education represents the new frontier for solidifying this intersection of the physical environment and human health, and there is a need to create a culture of design and health across the two fields. This need to create a common culture is especially important as designers, public health professionals, and other major influencers all have a separate approach to design and health, thus creating a challenge to work collaboratively.

The breakout discussion on Education highlighted five major institutional barriers to increasing cross-disciplinary work between design and health. Funding was noted as a major barrier, as there have been few financial resources available to encourage either faculty or students to work in the intersection of the design and health fields. Second, although mounting interest in design and health issues has been expressed by faculty in architecture and public health schools, there are few models that support cross-disciplinary work, leaving interested academic professionals without the tools and guidance necessary for navigating complex administrative processes. Additionally, the perspective of many architects is limited when discussing design and health. Often, "health" is immediately associated with healthcare facilities, rather than the broader public health implications of design across all types of buildings. Established procedures surrounding academic promotions also work as a barrier to creating this cross-disciplinary culture; university departments typically focus on traditional accomplishments within their own field when considering academic promotions, thereby giving junior faculty a disincentive to pursue cross-disciplinary work. Finally, accreditation standards

from the National Architectural Accrediting Board and the Council on Education for Public Health generally under-emphasize the topic of design's impact on health, thereby offering schools little incentive to explore the area and create curricula outside of electives.

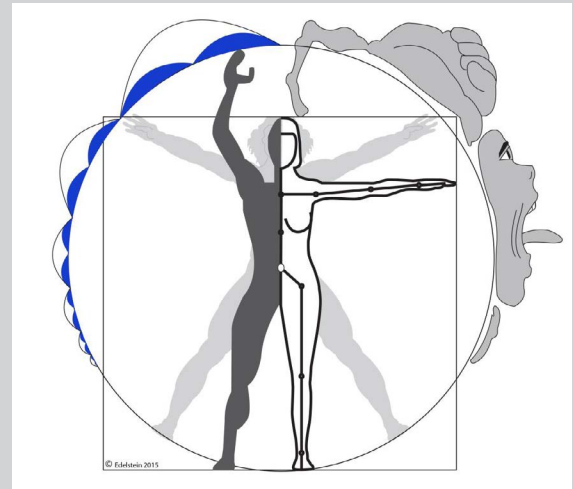
There is a multitude of contemporary efforts attempting to overcome these barriers to create a common culture. Agencies and groups including the Centers for Disease Control and Prevention, Active Living Research and the Urban Land Institute are actively participating in research linking design and health. Furthermore, an increasing number of universities and colleges are expanding their degree programs, courses and certificates to include cross-disciplinary faculty (or faculty teams) with expertise representing public health, medical / clinical science, neuroscience, psycho-social sciences, architecture, design, planning and landscape architecture. These broadening interests are evidenced by healthcare facility design groups such as the AIA Academy of Architecture for Health (AAH) and the American College of Healthcare Architects (ACHA), whose 2014 Summer Leadership Summit expanded threefold to include 30 schools from across the US that are delivering programs on design and health beyond healthcare facilities.

In addition to these on-going efforts, several other solutions to facilitate and accelerate a design and health cross-culture have been proposed:

- **Expand web presence to highlight best practices.** The digital landscape provides an ideal venue to share best practices of pedagogy, professional practice and policy. Existing sites, such as the [AIA's Design & Health landing page](#) or the [Built Environment and Public Health Clearinghouse](#) website could be augmented by resources, syllabi, studio courses, programs or case studies submitted by Consortium members. The BEPHC site was initially developed by Nisha Botchwey at Georgia Tech and features a wealth of resources focused on planning and health cross-disciplinary issues.
- **Advocate cross-curricular courses in the academy.** Ideally, every architecture student and every public health student would have at least some academic exposure to the topic of design and health as part of their routine curriculum. In addition, every architecture student and every public health student ideally would have access within their school to an elective course that further explores issues in design and health, with preference for cross-curricular courses. Several accredited architectural and design programs have incorporated design and health curricula in course modules, core seminars, design studios, theses and dissertations. The group realizes that effort is needed for accreditation bodies in either field to mandate such content. Recently, the Environmental Design and Research Association (EDRA) petitioned that architectural accreditation should maintain conditions focused on human-based design, social responsibility and research methods. Recognizing that architecture schools commonly use studios while public health schools commonly use practicums or capstone projects as methods of teaching, the development of an experience in design and health that could receive academic credit as both a studio and a practicum / capstone would be valuable.
- **Develop internships focused on cross-disciplinary projects at the nexus of design and health.** Such internships could cross disciplines of architecture with public health, medicine, neuroscience and engineering. Schools would need to review their accreditation and tuition policies to ensure such internships provided appropriate academic credit.
- **Encourage diverse and frequent publishing.** The group acknowledged that architecture and public health have different cultures on publishing evidence-based papers in peer-reviewed journals, so there is a need to disseminate information about design and health through multiple types of media. There is currently a small—but growing—body of

papers on architecture, design and public health outside of the well-established literature on the design of health-promoting healthcare facilities. Academic papers that could be written include an overview of the field of design and health for use in teaching the subject, as well as more detailed papers on specific topics within the field. Ideally such papers would be published in high impact peer-reviewed journals. In some cases, special theme issues of those journals would be most appropriate. Additionally, a number of websites offer resources relevant to healthy building design including [Active Design Guidelines](#) from New York City and [Active Living Research](#).

- **Leverage existing and partner conferences.** There is a need to reach broader audiences in architecture and health in professional settings, including large international and national conferences (such as AIA and ACSA) and in smaller regional meetings and colloquia. Ideally, such presentations would provide continuing education credits as an incentive for participation. Two sessions on design and health were presented at the March 2015 ACSA national meeting in Toronto.
- **Engage in new ways.** The group felt that a number of methods could be used to increase engagement, both within the design and health fields and with persons outside these fields. The group elevated several examples of replicable, impactful opportunities to connect broadly. Examples include developing interdisciplinary student competitions and relevant videos; museum exhibits such as [Design for Healthy Living](#) at the Museum of Design Atlanta; and the cross-disciplinary symposium hosted by Columbia University in 2014, [Conversations around Public Health, Architecture and Cities](#).



The 'Neuro-Architectural Scale' relating Vitruvius, the Modulus, Dreyfuss and the Homunculus.

The desire for 'human scale', considered by designers, philosophers and physiologists, has informed urban planning, architecture, ergonomics and neuro-architectural design. This illustration adapts seminal studies of human scale in terms of the golden section (Vitruvian Man by da Vinci), the modulus of a square (Corbusier's Modulor), and human factors (Dreyfuss). The 'neural scale' (upper right) illustrates the importance of the face and hand relative to the body, mapped as a homunculus (little man) on the motor cortex of the human brain during neurosurgery (Penfield and Rasmussen).

SOURCE: Illustration by Edelstein adapted from da Vinci (1490), Le Corbusier (1954), Dreyfuss (1955), Penfield & Rasmussen (1950). © Edelstein 2015

METRICS

Matthew Trowbridge, MD

Over the past two decades, broad-scale adoption of sustainable building practices has been accelerated by the emergence of user-friendly design guidelines and actionable metrics. As built environment professionals expand the notion of sustainability to target specific health and wellness outcomes in design projects, the earlier successes within the green building movement may provide a model to overcome existing barriers. Issues to broad adoption include the limited availability of data and metrics to measure performance of individual projects and a lack of professional accountability to health metrics. As the professional intersections between built environment and public health mature, the availability of actionable metrics and compelling incentives must be improved.

Although data from public health surveillance systems is available for many states, counties and cities, the emphasis on long-term outcomes, such as obesity and diabetes, and large geographic scale, such as zip code or county, renders the data insufficient for architects and developers who must demonstrate near-term economic value of specific infrastructural interventions, like a park or office complex. Nevertheless, these metrics—to the degree that they are available in a given community—are valuable in establishing community-relevant metrics that speak to broader goals for the community. These broader goals, for example crime prevention, can be achieved through specific and actionable metrics to define, measure and incentivize building scale solutions such as lighting.

Although data from public health surveillance systems is available for many communities, it often focuses on long-term outcomes, such as diabetes or obesity, and at the city, county, or state level. For architects and developers who must demonstrate short-term value propositions derived from singular infrastructural investments, such as a park or office complex, the metrics associated with

those systems are often not actionable. One challenge for the maturation of health-promotion in the built environment is the limited availability of health-related data and metrics to define and measure “performance” in the building sector. A second challenge lies in navigating the complex relationship between behavior (how one uses the space) and built environment.

It is unrealistic to anticipate a single set of health metrics that works for every community or project type. For example, the values that drive performance criteria in hospitals—“Did the patient die?”—are very different than those used in educational, residential or commercial project types; metrics used to evaluate reductions in crime are very different than those used to evaluate changes in physical activity or stress. Mapped against each other, however, these disparate frameworks may reveal new relationships, improve data collection and strengthen performance criteria necessary to catalyze market adoption.

The breakout group discussed two projects that reconciled long-standing public health efforts with industry-specific metrics to target health outcomes at the specific address level. [WalkScore](#) is a commercial website that leverages available measures to estimate walkability at the granular, individual address level. The [Mariposa Healthy Living Initiative Toolkit](#) is a publicly available tool adapted from the framework developed in the design and construction of Mariposa community in Denver, Colorado. The tool aggregates established health and building performance metrics from a variety of sources, including Enterprise Community Partners’ [Green Communities Framework](#) and the US Green Building Council’s [LEED program](#).

Mariposa Healthy Living Initiative Toolkit and *WalkScore* are both remarkable tools to drive designers and decision makers toward targeted health outcomes, but they are only a start. *WalkScore* doesn’t account for young, aging or disabled populations and the *Mariposa Toolkit* emphasizes quantitative measures for a handful of social

determinants. Recognizing these limitations, the group discussed three opportunities for the next generation of metrics.

Improve ease of surveillance methods

Traditional public health surveillance systems are resource-intensive. However, the widespread adoption of mobile technologies and interest in common metrics across disciplines may help reduce the time and cost of collecting health data. Person- and building-level data sources have the potential to strengthen existing and emerging performance criteria and improve the value proposition for non-health experts.

Supplement big data with field observation

Data can be a powerful tool, but it also requires context to properly apply it. As the quantity of available data expands—and with the proliferation of digital sensors and devices, it will—qualitative complements to big data will become more critical to understanding the complex relationship between behavior, health and place. Beyond providing a more comprehensive understanding of a community and its needs, qualitative observation invites empathy and logic that may elude codification. For example, if you are a child who is walking to school, your school may be a half-mile away but it is not really walkable if you have to cross a major road.

Consider performance-based contracts

As discussed above, actionable metrics and clear design guidelines have been core to advancing green building practices. As the quantitative and qualitative metrics which connect individual projects and targeted health outcomes improve, there will be increased pressure to consider the legal and practice implications of performance-based contracts. AIA, whose contract documents are the industry standard, has a unique opportunity to shape the direction of this conversation and educate members on the responsible application of metrics to practice.

“INTERNET OF THINGS”

Thomas Fisher, Assoc. AIA

The phrase “Internet of Things” (IoT) can have multitude meanings, depending on context. In order to set the bounds of the discussion, the IoT breakout group defined the term as: everything having its own URL or IP address. As smart-device use continues to permeate throughout all social, geographical and economic groups, humans will become more interconnected, and data regarding their behavior will become more accessible.

With this greater level of interconnectivity, however, comes challenges.

One concern for architects involves the relationship between a person’s health and metabolic data and the geographical and spatial data related to the environments we occupy, the vehicles we drive and the products and services we use. There needs to be better coordination of data across these scales. Related to this cross-scale data coordination is a need for stronger firewalls to protect personal data and security, as more and more personal data becomes integrated with technology.

At the same time, there exists the opposite dilemma of data becoming overly protected, making it difficult to “unlock” useful and important information. The problem of use agreements and the barriers of intellectual property can get in the way of the fluid exchange of information made possible by the IoT.

Wearable technology has already had a meaningful impact on individual health, enabling us to monitor a person’s health and allowing people to remain ambulatory as they age. Wearable technologies, for example, have enhanced people’s health and safety at home through the use of life alerts and other accident-monitoring devices.

The related phenomenon of health apps offer both opportunities and limitations, as they seem to benefit a healthier and more educated user group that need these apps the least. Our breakout group spent some time discussing the importance of encouraging healthy behavior and enabling people to “passively participate” without their having to actively use an app or change their lifestyle.

The group also discussed opportunities for funding research related to the IoT. Government entities such as NASA and the Air Force have taken the lead in the wearable technology area, and organizations that own and operate a lot of built space, like the General Services Administration (GSA), have led in the integration of space and equipment implicit in IoT.

At the same time, work in this area “falls between the cracks” of NSF or NIH funding, and the group wondered how the AIA might help make the case to funders of the importance of design and health research. Consortia models of funding, contract-based research for private entities, the use of social-impact bonds, and even other ways of doing this work by data mining the IoT and focusing on translational research are potential ways to meaningfully present research to funders.

Both architects and the medical community share this latter challenge: how to translate basic research into clinical or practice applications. Arguably, the medical community has made more progress on this front than architects. The IoT can provide a wealth of data that translational research can help turn into useful information thus enabling design professionals to make better, more informed decisions.

The group agreed that clients will drive much of this translational work, and that the AIA and the professional schools need better coordination and sharing of research information. Research has shown that a healthier population and a healthier built environment saves society money, which makes the value proposition of investing in better health clear. With so many benefits,

we can no longer *not* do the translational research needed to make this case.

Standard setting organizations—GSA, USGBC, ANSI—will also drive change by demanding more research-based decision-making. The practitioners in the group thought that the more that research can get folded into the design software that firms already use, as expert systems that notify design professionals of relevant data or information as they work, the more likely such research will get used. While highly skilled at integrating data sets, architects have less facility at using and conducting research, and so the research community needs to package and deliver the information in ways that will make it most relevant.

The group ended its discussion looking at ways of making research more accessible to practitioners and here too, the IoT can play a role. The linking of everything in the physical environment enables us not only to operate and monitor the physical environment more effectively, but also to provide feedback about its “post-occupancy” use and maintenance, which can then get folded into the design decisions of architects and designers. Ultimately IoT may prompt a level of research and informed decision-making in the architectural profession that many have talked about, but few have achieved.

RESILIENCE & EQUITY

Victor Rubin, MCP, PhD and Lynne M. Dearborn, PhD

Mounting evidence of the relationship between human health and conditions, whether planned or unplanned, of the physical environment have finally achieved salience in academic, professional and popular discourse. Health professionals, and to some extent policy makers, have responded by acknowledging that environmental modifications often should be part of a patient’s treatment plan. For example, remedies for asthmatic children include not only medications, but also the cleaning and ventilation equipment by which environmental triggers of asthma can be removed

from their homes. At the same time, some planning and design professionals are changing their traditional practices and areas of emphasis in an attempt to create environments that promote health and well-being. It's not enough for a doctor to tell his or her patients to walk, run or bicycle; their neighborhood has to make that behavior safe and practical, if not welcoming.

One important dimension of the relationship between the physical environment and human health, often unacknowledged by academics, professionals and the public, is the inequitable distribution of conditions that lead to sickness, poor health and reduced quality of life. Individuals who are members of a racial or ethnic minority as well as those with low incomes suffer disproportionately from environmentally linked diseases, chronic health conditions, reduced life expectancy and reduced general well-being. Yet the antecedent forces underlying inequitable exposure to deleterious environmental conditions remain unexamined in many contexts and are often bound up with a history of institutionalized prejudice. Resilience, whether at the individual or community scale, is implicitly linked to these questions of equity and exposure to harmful and unhealthy environments. As such, resilience in the context of health and environment must of necessity engage questions of race, ethnicity, income and institutionalized prejudice. This is needed even in a context where these dimensions of society require examination of some very difficult and complex problems that weave together physical, social, economic, cultural, racial and political threads.

The breakout discussion on health, equity and resilience brought out several important dimensions of these topics as they relate to each other and to the physical environment.

Equitable access to health-promoting environments should be a concern for the broader community. The negative health consequences provoked by harmful environmental conditions that disproportionately affect racial and ethnic minority groups and others with low

incomes underlie large and often unrecognized social and economic costs to society more broadly in the United States and elsewhere. For architects and allied professionals, this suggests framing the understanding of project clients in a broader context. The concern of professionals must be not only with paying clients but also with broader environment-health linkages, under the umbrella of professional responsibility to safeguard public health, safety and welfare. In these discussions, it is important that architects confront questions of equity, as these encroach upon design projects, and recognize the unintended and sometime inequitable consequences of design decision-making.

As leaders in the design process, architects must understand that environmental equity, as it relates to health and well-being outcomes, is not only about physical access to healthful environments but also about design processes and products that facilitate social and economic equity, increasing access to health-promoting lifestyle choices. Design and design process can in fact offer a catalyst for equity and community resilience. Resilience is a concept borrowed from psychology and suggests positive outcomes despite serious threats to human adaptation and development. In the context of the processes and products of environmental design, a focus on resilience necessitates recognition of both its social and physical dimensions. Thus, both the process and resulting environmental conditions can promote positive personal and community outcomes in the face of immediate catastrophe and more systemic threats such as climate change, economic instability and stresses of modern life. A focus on resilience in environmental design could be applied as a series of preventive strategies that support community participation in the design process as well as resultant environments that promote health, encourage healthy activities of everyday life, and enable the capacity to recover from significant traumas and adversities.

A number of endeavors critical to better understanding and promoting a positive health, equity and resilience

agenda in relationship to the design of environments surfaced as a result of the breakout discussion. Chief among these are understanding and defining the problem through a response to the following questions:

1. What are the possible ways to measure inequality and equity?
2. How should resilience be defined in the context of environmental equity?
3. Once defined, how can it be effectively and appropriately measured?

Developing responses to these questions will offer a shared understanding on which to build a research and design agenda in this area. It will then be possible to begin to measure the impacts of changing processes and environmental conditions on health, well-being and resilience. Measurements of impact will provide the evidence necessary to prompt changes in policy, design processes and environments to address the agenda of health equity and resilience.

TRANSLATION

Whitney Austin Gray, PhD, LEED AP and Joanna Lombard, RA, LEED AP

High points: research & impacts

Reviewing past pivotal contributions, participants of the Translation discussion noted the Institute of Medicine (IOM) reports which specifically focus on built environment impacts on physical activity (2005)^a and obesity (2012).^b The reports have inspired collaborations

across design and public health disciplines. The *Patient Protection and Affordable Care Act* of 2010 requirement for charitable hospital organizations to provide community health needs assessment (CHNA)^c has provided new incentives to develop processes and toolkits to evaluate and assist in measuring the built environment's impact on population health.^d The rise of Team Science, an approach to research that engages multi-disciplinary and cross-institutional collaborations in research and translation, has helped to advance innovative translation projects. Emerging through a 2006 National Cancer Institute conference, the National Institutes of Health (NIH) established the Clinical and Translational Science Award (CTSA) program, and the approach was a feature of a widely circulated issue of the *American Journal of Preventive Medicine* (2008).^e In 2013, the IOM reviewed CTSA sites in 61 medical research institutions in 30 states and DC,^f noting the need for greater advances in "innovation in education and training," and "community engagement," which are particularly relevant to the discussion today. Professionals and academics in architecture participated in the larger work described above, and more specific to healthcare design, Jaynelle Stichler and Kirk Hamilton, with the Center for Health Design and the Vendome group, in 2007 launched *Health Environments Research & Design (HERD)*, now published by Sage, which provides a critical venue for the publication of research and scholarship in the area of healthcare design.^g

c <http://www.cdc.gov/policy/chna/>

d The Center for Applied Research and Environmental Systems (CARES), a mapping and data visualization center at the University of Missouri, partners to host Community Commons which provides a CHNA toolkit that is widely used: <http://assessment.community-commons.org/CHNA/About.aspx>

e http://cancercontrol.cancer.gov/brp/scienceteam/ajpm_complete.pdf

f <http://www.ncats.nih.gov/research/cts/ctsa/about/iom/iom.html>

g Jaynelle Stichler, Kirk Hamilton, "Welcome from the editors of HERD," *Health Environments Research & Design Journal*, October 2007 vol. 1 no. 1: 4, <http://her.sagepub.com/content/1/1/4.full>

a IOM (Institute of Medicine). 2005. *Does the Built Environment Influence Physical Activity? Examining the Evidence*. Washington DC: The National Academies Press (Special Report No. 282). <http://onlinepubs.trb.org/onlinepubs/sr/sr282.pdf>

b IOM (Institute of Medicine). 2012. *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*. Washington, DC: The National Academies Press. <http://www.iom.edu/Reports/2012/Accelerating-Progress-in-Obesity-Prevention.aspx>

Translation & impacts

The impact that a large body of collaborative research has had on translation can be seen through three notable high points. RWJF's Active Living Program (2001-13)^h enabled multiple, innovative translation projects. A recipient of a 2011 RWJF Award, the *Active Design Guidelines*ⁱ resulted from collaboration among multiple New York City agencies, the American Institute of Architects New York City Chapter, private sector architects and developers, and academic partners. Adopted by the Bloomberg administration, the *Guidelines* generated a new LEED credit, continue to provide training through AIA chapters and are now embedded in the Center for Active Design.^j Advancing the translation of *HERD*, The Center for Health Design developed the Evidence-based Design Accreditation and Certification program (EDAC) as a method of education and certification for designers, healthcare providers, academic, students and related industry. EDAC serves as a model for rapid translation of research into practice. The most recent advancement is the establishment of the AIA Design & Health Leadership Group and the present AIA Design and Health Research Consortium.

Future direction & actions

Considering the growing and converging awareness and interests in the health impacts of the built environment, there are many opportunities that would build on the work accomplished and expand into new areas to both generate further actions and to develop the professional capacity to support current needs. Focusing on the larger community, new opportunities for education and engagement include the use of individual narratives as a portal to learning; the potential for community based research, such as the Communities and Schools Together for Childhood Obesity

h <http://activelivingresearch.org/aboutus>

i <http://centerforactivedesign.org/guidelines/>

j <http://centerforactivedesign.org/about/>

Prevention in Oregon project,^k to build awareness and incentive for action, and increased use of participatory planning and assessments.

Looking to the education of citizens and professionals, the 2005 IOM call for interdisciplinary programs remains an area of opportunity. A practicum that engages architecture students with internships in design and health not-for-profits would be a significant advance in this regard. Lastly, collaborative professional education credits provide a substantial opportunity to integrate learning across multiple professions to advance knowledge and develop new associations and partnerships. Professional organization with potential for shared CEUs include the AIA, American Society of Interior Designers (ASID), American Society of Landscape Architects (ASLA), American Planning Association (APA), American Public Health Association (APHA), National Recreation and Park Association (NRPA), Society for Experiential Graphic Design (SEGD), American Institute of Graphic Arts (AIGA) as well as advocacy and interest groups, such as the U.S. Green Building Council (USGBC).

Immediate actions:

- Architecture student practicum
- Collaborative professional education
- Community-based research

User sessions

RESEARCH IN BUILT ENVIRONMENT PRACTICES

Rachel MacCleery, Senior Vice President, Content, Urban Land Institute, shared the [Building Health Places Toolkit](#), a new resource that leverages existing research to identify opportunities to enhance health through real estate decision making. 21 recommendations are organized into three categories:

k http://www.ori.org/research/detail/communities_and_schools_together_for_childhood_obesity_prevention

physical activity, healthy food and drinking water, and healthy environment and social well-being. The group discussed ways to connect real estate developers with Consortium members to improve the measurements of health outcomes at the project level.

Whitney Austin Gray, PhD, LEED AP, Executive Director of Research and Innovation, Delos, discussed the challenges associated with getting the owner & client to invest in the shared movement around health and well-being through design. She elaborated on the process undertaken by the International Well Building Institute, a public benefit corporation, to deliver the [WELL Building Standard](#) as a roadmap to healthy buildings and healthy behaviors. The standard went through 32 versions including a scientific review, practitioner review and medical review.

RESEARCH IN HEALTH PRACTICE

Sandra Whitehead, PhD, Director of Healthy Community Design, National Association of County & City Health Officials, shared how NACCHO and its members are embracing health impact assessments (HIAs) as a vehicle to apply research to practice. Often, the HIAs examine issues related to parks and open space, access to fresh food, walkability, environmental health and others closely aligned with Consortium research efforts. She emphasized the need for more granular metrics that evaluate the return on investment and targeted health benefits of individual elements at the building, neighborhood and community scale. The group discussed opportunities to integrate HIA processes in the architectural studio curriculum as a means to expose students to health concepts.

Sarah Schaefer, US Department of Housing and Urban Development, offered examples of successful health-focused projects in Lehigh Valley, East New York, Boston, Seattle and Denver's Mariposa Community, to build a case for HUD's interest in research connecting design and health. HUD's limited research dollars

are appropriated by Congress, but have far-reaching effects on the design and evaluation of HUD programs and policies. Examples of programs that are informed by design and health research include: Choice Neighborhoods, Promise Zones and Sustainable Communities. The group discussed opportunities to encourage greater Federal funding for research that promotes sustainable and inclusive communities.

Member Presentations

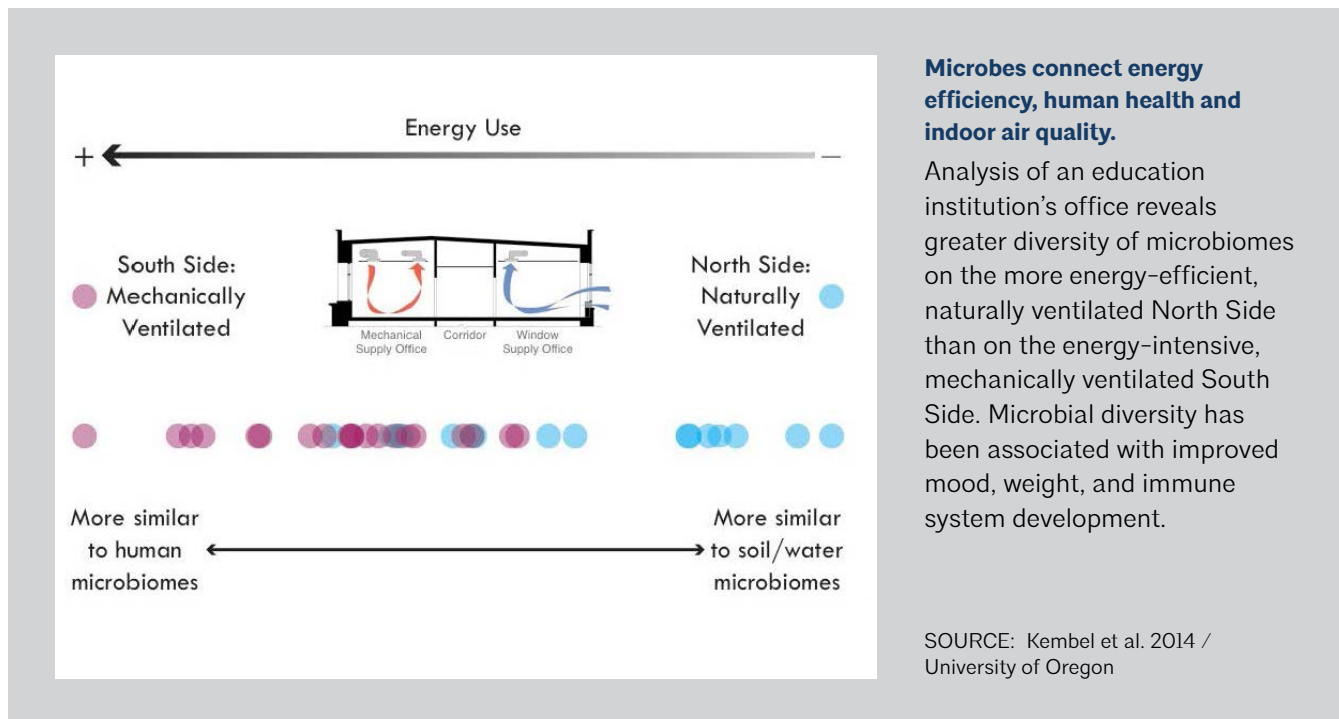
ENVIRONMENTAL QUALITY

Research links indoor air quality with energy and health performance

Indoor air quality (IAQ) has been recognized as a factor affecting the health and well-being of people for more than a century by both architects and public health professionals. Although 19th century designers may not have anticipated the emerging evidence connecting IAQ with reproductive health, morbidity and mortality, the passive design strategies used to promote ventilation and moisture mitigation increasingly demonstrate sensitivity to the relationship between built environment and human health.

Research into IAQ's impact on public health took off in the 1980s. Medical and public-health researchers since then have discovered quantifiable and qualitative differences between outdoor and indoor air, and uncovered new and previously unsuspected connections between IAQ and reproductive health, morbidity and mortality. Americans spend approximately 90% of their time indoors where they breathe airborne chemicals, microbes, fungi and biological byproducts that may cause or exacerbate illness, allergies, infections and some cancers. Public-health experts now estimate that 2 million people around the world die each year from conditions related to IAQ, particularly poor ventilation.

Another important environmentally-related public issue that rose to prominence during the 1970s' oil crisis is energy consumption. Buildings consume between 40



and 50 percent of U.S. energy production; two-fifths of buildings' energy usage is related to systems that cool, heat and circulate indoor air. Architects, engineers and builders who are sensitive to the relationship between the built environment and human health are utilizing passive-energy design strategies to promote ventilation and mitigate moisture while at the same time reducing energy consumption.

The University of Oregon team is exploring the link between indoor environmental quality and buildings' energy use at an unusual connection point: in microbes. These microscopic organisms—including bacteria, viruses and fungi—are found on and frequently in everything with which humans interact, including our bodies. These single-cell organisms are not always harmful. Contemporary research has associated microbial diversity with improvements in individuals' mood, weight and immune system development.

The University of Oregon team's studies of rooms for hospital patients and an educational institution's offices found that natural-design strategies used to meet those buildings' energy-efficiency goals—such as integrating operable windows and active daylighting controls to affect thermal conditions—may have co-benefits for the occupants' immune system tolerances, asthma, and allergies. According to G.Z. Brown, the microbiomes

of the naturally-ventilated spaces in each project were more similar to the diverse, outdoor-associated microbes associated with health than the microbiomes in the mechanically-ventilated control spaces.

At the University of Florida, a team plans to integrate lab-on-a-chip technology with small, portable sensors to monitor IAQ of complex compounds in third-hand smoke and flame retardant materials. These devices will work in near-real time to analyze and report indoor pollutant concentrations in consumer friendly, meaningful ways, and to better assess indoor environmental health of rental units as they transition from one occupant to the next.

The growing interest in IAQ as a public-health concern has not ended investigations of the outdoor environment's effects on people's health. Traffic pollution has been identified as a major asthma trigger, yet, as noted by a member of the University of Illinois team, there has been a proliferation of zoning policies that concentrate higher densities of vulnerable populations near interstate highways. Ray Pentecost from Texas Tech University reminded participants of the Princeton convening that pollutant concentrations vary by geography and community type; he pointed out unique rural issues related to agricultural waste and arsenic water as examples.

“The research findings regarding stress and nature, by Roger Ulrich, Terry Hartig, Stephen and Rachel Kaplan, and others, have convinced the medical world that designed natural areas in healthcare settings are not just cosmetic niceties, but actually facilitate the healing of patients and the restoration of busy staff and worried visitors.”

—Richard Louv in “Children and the Success of Biophilic Design.” *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life*.

Midwestern communities. The Midwest leads other U.S. regions in all nine physical symptoms of stress, including irritability (49%), nervousness (47%) and headache (34%). Even though exercise is an effective remedy for stress, the survey also found that Midwesterners are less likely than other Americans to try to be physically active.

NATURAL SYSTEMS

Drawing on nature to improve the built environment

There’s no question that being exposed to nature in its benign forms—trees, grasses, free-form rocks and flowing streams, etc.—contributes to human health and well-being. Poets and philosophers over centuries have rhapsodized about nature’s effects, and contemporary studies continue to discover new connections to public health, such as Spanish researchers’ finding in 2013 that living in areas with more plants and vegetation during pregnancy may increase fetal growth. “Greenery factors” are broadly acknowledged and incorporated in both building and community design, but many population groups still don’t have equal access to these natural spaces. Three Consortium teams at the Princeton convening reported on efforts to provide vulnerable populations with improved access to nature in order to relieve stress, mitigate social problems and increase resiliency.

Midwest’s wide-open spaces harbor hidden pools of stress

Many Americans have an image of the Midwest as a place with abundant wide-open green spaces—corn and wheat fields, forests and pastures. It might surprise them that the Midwest also holds widespread pools of stress. Describing research under way at University of Illinois at Champaign-Urbana, Lynne Dearborn cited the 2011 *Stress in America* survey’s report on the vulnerability of sometimes-isolated

The University of Illinois team is working with community partners in Rockford and Champaign counties to develop and test evidence-based design tools and implementable policies to promote development and use of restorative environments that offer people the opportunity to reduce stress, especially in smaller cities. Dearborn said the research will contribute to a growing body of knowledge about linkages between natural systems and reduced crime; increased safety; and improved ability to respond to social, sensory and physical conditions.

How much can adding greenery improve well-being?

The University of Miami team, like the University of Illinois team, emphasized the importance of involving community partners in designing, implementing and assessing interventions to promote health. University of Miami has partnered with Maria Nardi and her team at Miami-Dade County Parks, Recreation and Open Spaces (MDPROS) on a three-year pilot project to evaluate the environmental, population and individual health effects of adding greenery to parks in low- and middle-income neighborhoods. MDPROS will plant new park and street-side trees at target sites. University of Miami will conduct pre- and post-intervention assessments at control sites and the improved parks. The study’s results will help planners allocate capital resources for future design-based evaluations and interventions in Miami-Dade and nationally.

Leveraging small changes to make significant improvements

The University of Kansas team is proving that designers with their health partners can leverage small changes in existing systems to make significant improvements in people's access to green spaces and another product of natural systems: healthy food options. In the course of mapping parts of the 15-county Kansas City Metropolitan Area, the University of Kansas team illustrated sharp inequalities defined by socio-political boundaries; i.e., county lines. Wyandotte and Johnson counties are side-by-side geographically, but they occupy opposite ends of rankings of health factors in Kansas counties. Johnson County outperforms nearly every Kansas county in health behaviors, quality of life, social & environment factors and physical activity; only 3% of its population—compared to 14% of Wyandotte County's—is disadvantaged by limited access to healthy food options. The USDA defines "access" in geographic terms: the nearest supermarket or grocery store must be within one mile from urban residents or 10 miles in rural areas. Wyandotte County's local government can't directly build grocery stores, and it doesn't have the resources to address other factors that create food deserts, including people's individual behavior and cultural dietary preferences. What the county government could do was work with the University of Kansas team to change the existing public-transportation infrastructure. The solution: siting bus stops within a half-mile of existing food outlets and green spaces. The project, "Connecting the Dots," illustrates how seemingly minor design-based approaches to health can accelerate improvements in American communities of any size.

PHYSICAL ACTIVITY

How to make people more active by design

Andrew Rundle from the Columbia University team reported on an epidemiological study of the role of urban form and design in promoting physical activity in New

York City. The research team monitored physical activity with accelerometers and geographic positioning systems and identified a relationship between weekly physical activity and a neighborhood's walkability. Adjusted for gender, age, race, ethnicity, household income and local homicide rates, the data found a 100-minutes-per-week difference in moderate physical activity between the most- and least-walkable neighborhoods in the study area. Public-health experts recommend 150 minutes of weekly moderate physical activity to improve cardiovascular health and prevent heart disease and stroke.

Building on a body of knowledge

Since 1983, the Texas A&M University's Center for Health Systems and Design has been pioneering translation and evaluation efforts to move active-living and community-design research into practice and policy. Its efforts—including a recent assessment of LEED for New Development's (LEED-ND) impact on residents' physical and social health in Mueller, Texas—often embrace the dynamic combination of research, implementation, policy and education that is essential to building a culture of health across America.

Offering further examples of research applied to practice, Yvonne Michael and Debra Rubens from Drexel University presented two case studies in which design supported community efforts to increase physical activity. One involved the 2012 installation of a restorative garden at Presbyterian Apartments, a HUD low-income housing unit. Drexel's team conducted a survey to learn how residents used the new space. The survey resulted in a recommendation to establish a resident-led walking group to encourage the space's use, increase physical activity and foster social connectedness among facility residents. The second considered a playground at the McMichael School (page 31).

Beyond density, diversity & design

Much of the literature around design for active living and walkable communities has evaluated densely-populated, mixed-use communities designed to promote active

commuting, physical activity and access to healthy food; Rundle calls these features—density, diversity and design—the “Three D’s.”

But the reality of the modern landscape is one in which the *Three D’s* are inequitably distributed. New frontiers of inquiry will look to measure communities’ resilience in the face of infrastructural challenges that characterize unplanned developments and rural communities; and to develop new methods to correlate physical and social health. Indeed, several Consortium teams have already begun to evaluate applicability of existing research and methodologies in communities where the *Three D’s* aren’t guaranteed. Texas Tech University’s focus on west Texas highlights the barriers that a low-density region presents to walkability. University of Miami centers on overcoming the challenges of homogeneously-designed communities to the needs of diverse and vulnerable populations. Finally, Columbia University’s work in Brazil considers the portability of physical activity promotion to unplanned communities.

Rural communities struggle with challenges that design might remediate

Speaking for Texas Tech University’s team, Ray Pentecost (who’s also a member of the AIA Design & Health Leadership Group) invited the Consortium members to recall the classic TV show “Green Acres” in which Eddie Albert demands “Fresh air!” and Eva Gabor wants “Times Square!” Albert’s exclamation concisely describes an uncomplicated, healthful, idyllic existence that Pentecost said is unrealized among many of the one in five Americans who live in rural areas. Rather, many rural communities struggle with limited transportation networks, low walkability, high perceived social isolation and other compounding environmental health hazards. Texas Tech University’s team will investigate strategies to increase lifespan and well-being in the absence of dense population clusters. By keeping a laser-like focus on legal, business and design challenges unique to the 108 counties of West

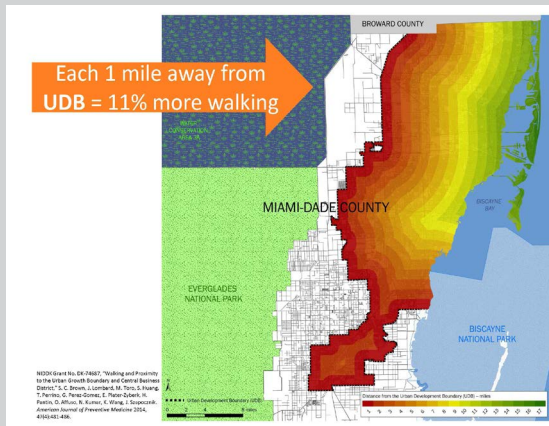
Texas—98 of them classified as rural and 54 with fewer than seven persons per square mile—the Texas Tech University team will make recommendations and suggest policy interventions that may become models for other states’ rural communities.

Living at the city limits puts an edge on life

Joanna Lombard and Scott Brown from the University of Miami team discussed how the well-being of vulnerable populations is affected by living in a homogeneous community on the urban edge of Miami-Dade County. Real estate development is constrained on the east by the Atlantic Ocean and to the west and south by an urban development boundary (UDB). The UDB is a zoning construct used to protect the Florida Everglades from urban encroachment, but the University of Miami team has found that a resident’s proximity to the UDB may also be a predictor of his or her physical activity. Studying 391 recent Cuban immigrants, the research team found an 11% increase in purposive walking for each one-mile increment in residence inward from the UDB, and the team also found a correlation between purposive walking and the existence of more mixed-use zoning, parks and walking destinations in the urban center than at the suburban edge. In a related study, the team was able to positively associate living in mixed-use neighborhoods in Miami with improved academic performance. All other factors being equal, it appears that living nearer the UDB puts people beginning life in America at a greater disadvantage compared to those living nearer the urban core. It’s more evidence of the role that the built environment plays in giving people equal opportunities to succeed in life.

Applying lessons from New York City to improve health in Brazil’s poorest favela

Andrew Rundle from the Columbia University team, who also reported on an epidemiological study of the role of urban form and design in promoting physical activity in New York City, outlined the challenges his



Zoning policy as a determinant of physical activity.

University of Miami researchers found an 11% increase in purposive walking for each one-mile increment inward from the urban development boundary. The UDB is a zoning construct used to protect the Florida Everglades from urban encroachment.

SOURCE: Brown et al. 2014 / University of Miami

colleagues face in doing the same sort of study in densely populated Rio das Padras, the third largest favela in Rio de Janeiro, Brazil. Home to more than 63,000 people, Rio das Padras lacks basic health services and any organized infrastructure. Understanding the replicability of public health methodologies in such unplanned settlements is critically important, Rundle said, because the number of people living in similar environments continues to rise. UN Habitat predicts that nearly 1.5 billion people in 2020 will live in overcrowded communities with insecure tenancy, poor sanitation, inadequate housing structures and unsafe water.

SAFETY

Smart sensors may target safety hazards in detail

HSW (the initials stand for Health, Safety and Welfare) is at the core of an architect's obligations to his or her clients, colleagues and community. It's considered so important that the AIA requires its members to earn annual continuing-education credits in appropriate HSW courses, as do many states whose laws require continuing education for architects' licensure. AIA expanded the definition of "safety" beyond using architecture to protect people from physical harm to also protecting individuals from psychological harm and protecting the health of the population as a whole. Although the Consortium's university members come from other areas of professional specialization and academic expertise, a shared concern for people's health, safety and welfare was manifest in all of the team's presentations.

Pinpointing hot spots for falls in senior-citizen communities

Recognizing that homes are intertwined with the communities in which we reside, the University of Florida team is re-envisioning the entire experience of active living in an aging context from home to community infrastructure. During her presentation, University of Florida team member Sherry Ahrentzen commented on the emergence of age-responsive sensors and smart devices that may help identify hot spots of resident falls, better design and improve healthcare response.

Ahrentzen and company are not the only Consortium team to explore the opportunities afforded by digital innovations and the IoT. The NewSchool for Architecture & Design and University of Arizona teams discussed devices and sensors they are independently developing and deploying. Among the more talked about devices were Smart Sox, currently being tested at the University of Arizona. The socks use sensors and fiber optic cables to improve the quality of life of diabetics by monitoring temperature, pressure and stress before ulcers have the opportunity to form.

Before: Poor air quality; artificial lighting; background noise



After: Improved air quality; natural daylighting; quiet room



Designing office environments to reduce stress.

Researchers at the University of Arizona measured stress responses in prototypical office environments before and after design interventions to improve air, light and noise quality.

SOURCE: Casey Lindberg, PhD / University of Arizona

SENSORY ENVIRONMENTS

Digital devices give new insights into how buildings work

Clients are increasingly demanding health-promoting buildings, which require enough flexibility for occupants to adapt environments to their own needs. Yet, many of today's building standards are not formulated to address physical and mental health conditions of occupants. As new devices and sensors facilitate greater insight to the health outcomes and co-benefits of well-designed built environments, Consortium teams are poised to influence a conversation about how design-based policy drives high-performing buildings and people.

"Sensorium" measures neurological responses to design

One opportunity for Consortium teams, explained Eve Edelstein, is to incorporate data from devices and sensors, like those prevalent in University of Florida's work, into the design process. The NewSchool for Architecture and Design has established a "Sensorium" to provide a venue to evaluate the neurological impact of architecture through built environment simulations. Working with a suite of university and private partners, including Arup, Gensler and others, the team is able to predict—with or without synchronous biometric tracking—human responses to design strategies affecting movement & memory, light & location, and natural systems.

Evidence-based strategies to reduce stress, induce calm

Esther Sternberg, Director of the University of Arizona Institute on Place and Wellbeing, and Shane Ida Smith,

a dynamic Assistant Professor at the University of Arizona, were more specific as they discussed how different elements of place influence occupant health and well-being through stress and calm. In partnership with its sponsors at GSA, the University of Arizona is testing innovative methods utilizing non-invasive human sensing devices integrated with environmental sensing are providing for emerging baseline metrics to quantify and qualify the impact of built environment design on human health. Researchers are comparing stress and relaxation responses in a prototypical office environment versus another space outfitted with improved light, sound quality and access to natural systems. In previous published studies, Sternberg and colleagues from the National Institutes of Health and GSA reported that occupants of sustainably retrofitted office spaces exhibited lower physiological stress responses than in legacy space.

Smith and her colleagues have already begun to apply the lessons learned to practice and policy. In partnership with the University's Drachman Design-Build Coalition, the team has imbued a new affordable housing project with evidence-based design strategies to reduce stress and promote well-being of residents. Through advisory capacities, briefings and other relationships with non-profit and government agencies, including the Department of Defense, Department of Veteran Affairs, GSA and the Surgeon General's Office, the University of Arizona team is working to see human health and well-being outcomes inform green design standards.

Designing thermal systems for individuals' specific needs

Likewise, the University of Florida team recognizes the opportunity to use health to inform design and building standards. Seamlessly navigating built environment policy and health research, Ahrentzen juxtaposed ASHRAE 55-2010 (Thermal Environmental Conditions for Human Occupancy), with evidence that associates reduced indoor temperature spikes in homes with improved sleep patterns and fewer instances of reported depression to suggest the potential for building standards to promote health for all. In its current form, ASHRAE 55-2010 does not address specific requirements for children, the disabled or the infirm.

SOCIAL CONNECTEDNESS

How to make communities healthier for everyone

A healthy built environment is one which all people have equal opportunities to thrive in the place in which they live, learn, work and play. Unfortunately, the social fabric of our communities often exacerbates disparities in health conditions. From the belief that a community can only be as healthy as its least-healthy citizen, the AIA has encouraged Consortium members to consider the social dynamic in communities on which they work, and to ensure that improving equity and strong social relationships have equal footing with consideration of improvements in health and well-being.

Connecting people in unique communities demands tailored solutions

Health equity is a thread weaving together many teams' work. Texas A&M has leveraged improvements in walkability to increase social interaction among neighbors. Columbia University's project in the Rio das Padras favela lays the groundwork to improve health and to overcome intense, unregulated poverty. University of Florida shines its light on the unique physical, mental and emotional needs of aging

populations. University of Kansas is forging alternate health-care models in which a range of environmental, cultural and socio-economic factors can change the fundamental way in which communities connect and thrive. Texas Tech University and University of Illinois teams are studying the human cost of a reduced sense of community in low-density population areas and found, for example, that young people's suicide rates are nearly two times higher in rural communities.

University utilizes multi-disciplinary approach to rehabilitate community

Drexel University hopes to improve the health and economic opportunities in an area with deep and persistent poverty by involving community members in rehabilitation efforts. The target is Mantua, a low-wealth neighborhood of West Philadelphia in a two-square-mile designated Promise Zone. Federal partnerships will create jobs, leverage private investment, increase economic activity, expand educational opportunities and reduce violent crime over the next few years. Yvonne Michael and Debra Rubens told the Consortium participants that Drexel plans to use the Dornsife Center, which administers a variety of community programs, as a venue where local residents alongside university students, faculty and staff will work together in efforts to solve the most intractable problems affecting the health and well-being of Mantua residents. In a related effort, a Drexel team already is working at the McMichael School where university students are collecting baseline social and physical data prior to the opening in 2015 of a new, clean, sustainable and safe playground. The playground incorporates natural systems, including trees, with the goal of increasing social connectedness, encouraging physical activity and improving sensory environments. After the playground has been in operation for some time, the Drexel team will conduct a follow-up assessment of its utilization and social impact, and those findings may inform future interventions in the Mantua area.

4. Conclusion



Michael Monti, PhD, Executive Director of the Association of Collegiate Schools of Architecture, encouraged attendees to serve as peers to each other as they collectively advance an integrated set of research priorities.

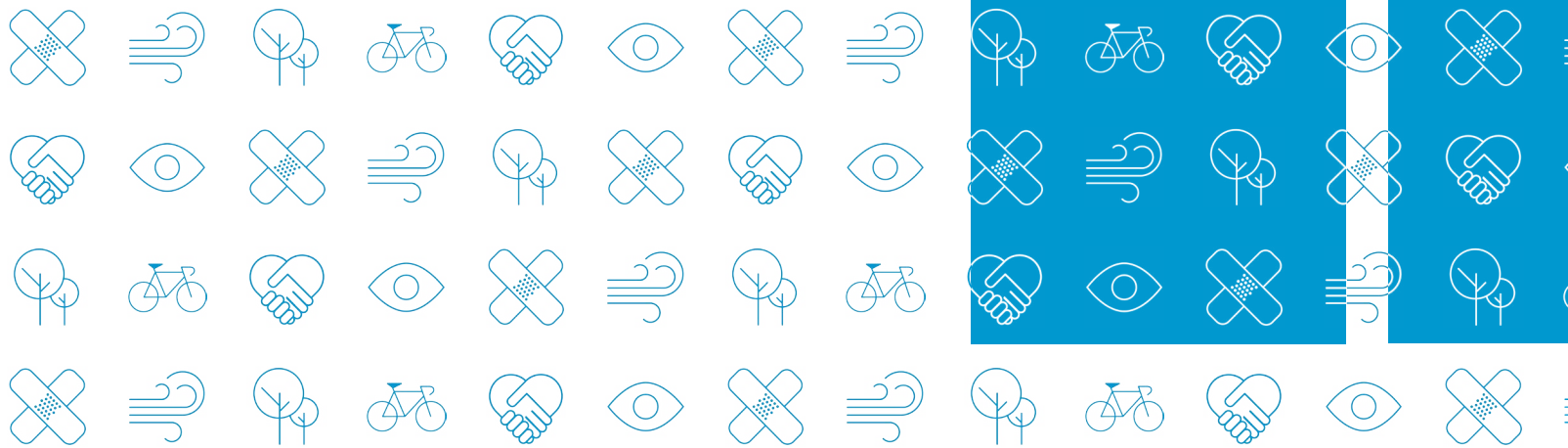
SOURCE: John Schneidawind

Conclusion

The convening of the AIA Design & Health Research Consortium inaugural cohort merely previewed the potential of researchers from across disciplines to evince thoughtful, healthful design transformations in communities where we live, work, play and learn. The period ahead is bright and rich with content. Indeed, a priority of the Consortium moving forward will be to define and discuss the ways in which the themes and opportunities from each table discussion can be built into a broader, integrated set of research priorities. For instance, it is clear that whatever advances we make in **Education** will help to drive the development of next-generation **Metrics** that can provide more actionable data on built environment health performance. The **Internet of Things, Resilience & Equity** and **Metrics** are inextricably linked to one another, as more granular data enables us to have a better understanding of the root causes of inequity, and to develop a system for measuring progress toward equality.

However, in addition to the collaborations and opportunities identified in this report there are dozens more that have gone unarticulated. As communities coalesce around a culture of health that emphasizes the design of the built environment, they will need the support of industries including insurance, computer technologies, emergency management and business. As we consider resilience in the discourse of design and health, we should also anticipate resilient partnerships across scales. Only then will true impact happen in communities.

The AIA Design & Health Research Consortium has provided a vehicle for built environment professionals to join colleagues from public health and health care in a conversation around improving the utility and validity of research at the forefront of America's health. AIA and its partners encourage continued collaboration within and between teams to drive demand and realization of well-designed, healthy places.



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