HEALTH IN CONTEXT

A new role for green building design

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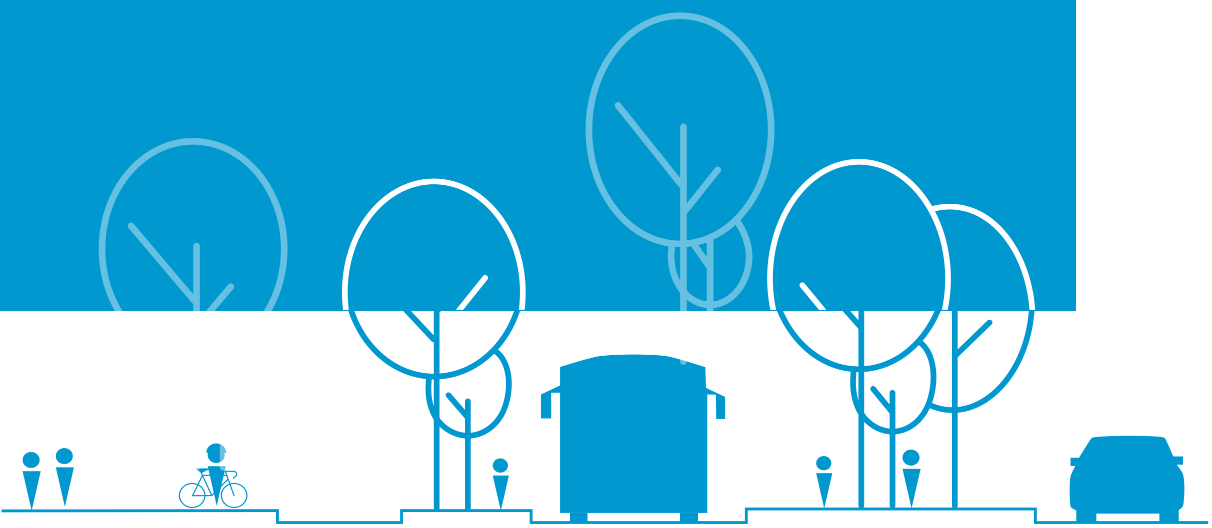

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Design: Setting the Context for Health

By shaping the built and natural environment, design sets the context for many of today's most pressing health concerns. For example, chronic disease is by far the highest cause of mortality in the U.S. (Hoyert & Xu, 2012). It also accounts for more than 75% of the $2.6 trillion spent each year on medical care (Martin, Lassman, Whittle, & Catlin, 2011). Chronic medical conditions associated with modifiable risk factors (e.g., smoking, nutrition, weight, and physical activity) represented 6 of the 10 costliest medical conditions in the United States with a combined medical-care expenditure of $338 billion in 2008 (Soni, 2011). Those same six largely preventable conditions accounted for 29 percent of the total increase in U.S. medical care spending during the 1987-2000 period (Thorpe, Florence, & Joski, 2004; Thorpe, Ogden, & Galactionova, 2010).

While the built environment can't solve this challenge on its own, it is a major contributor to both the problem and its ultimate solution. For example, in spite of the fact that the majority of health-care spending has been directed to increasing access to clinical care, designing a supportive environment can actually be twice as influential in reducing the burden of disease (Bipartisan Policy Center, 2012).

The health effects of climate change follow a similar scenario. Extreme weather events do not affect all neighborhoods equally. Some populations are more at risk of negative health outcomes than others because of the social, economic, demographic, and/or environmental characteristics of the neighborhoods where they live, work, and play (Balbus & Malina, 2009). With the number of $1-billion natural disasters increasing at an average rate of 5% per year, the economic case for preparedness is clear (Smith & Katz, 2013). A billion dollars is a huge sum, but these damage estimates only include the losses due to an extreme weather event's direct impact on property, other assets and infrastructure. When the direct health costs are also factored in, the economic burden associated with these events is much higher. For example, Knowlton (2011) estimated that the health costs associated with just six climate change-related events over the past decade resulted in an additional $14 billion. Modifying the built environment to prepare for the anticipated changes associated with climate change can yield substantial results—along the lines of a $15 return on each dollar of investment (Healy & Malhotra, 2009).

Zoning regulations and master plans for land use and development can promote safe, healthy choices at the community or regional scale, but developers and their project teams ultimately decide whether or not to incorporate specific design strategies into individual projects. Their decisions have the ability to directly benefit building occupants and to enhance health equity in the surrounding community. With access to the appropriate tools and data, architects are ideally positioned to identify the localized health needs of a specific project site and modify their design accordingly.

FIGURE 1: Literature review results

LEED Credits (description)	**Extreme Heat Resilience Literature Review**	**Flooding Resilience Literature Review**
SSc1: Site Selection Avoid building on: prime farmland; land in 100-year flood plain; endangered species habitat; land within 100 feet of wetlands or 50 feet of water bodies; park land.	●	●
SSc2: Development Density and Community Connectivity Locate project in a dense urban area or close to both a residential area and at least 10 basic services (i.e., grocery stores, etc.)	●	
SSc4.1: Alternative Transportation—Public Transportation Access Locate project near bus/rail lines.		●
SSc4.4: Alternative Transportation—Parking Capacity Provide preferred parking areas for carpools/vanpools.		●
SSc5.1: Site Development—Protect or Restore Habitat Limit disturbance of habitat on greenfield sites. Restore habitat on previously developed habitat.	●	●
SSc5.2: Site Development—Maximize Open Space Increase vegetated open space.	●	●
SSc6.1: Stormwater Design—Quantity Control Reduce the volume of stormwater that leaves the site after heavy precipitation events.	●	●
SSc6.2: Stormwater Design—Quality Control Clean stormwater of total suspended solids.	●	●
SSc7.1: Heat Island Effect—Nonroof Install light colored and pervious paving (i.e., roads, sidewalks, parking lots, etc) or place at least 1/2 of all parking spaces under cover.	●	●
SSc7.2: Heat Island Effect—Roof Install light colored or vegetated roofs.	●	●
WEc1: Water Efficient Landscaping Reduce potable water use for irrigation by 50% or 100%.		●
WEc2: Innovative Wastewater Technologies Reduce potable water use for sewage conveyance.		●
WEc3: Water Use Reduction Reduce potable water use for interior fixtures (i.e., toilets, lavatories, showers, etc.)		●
EAc1: Optimize Energy Performance Reduce energy use in the building.	●	
EAc2: On-Site Renewable Energy On-site installation of solar, wind, or other renewable energy source.	●	
EAc3: Enhanced Commissioning Perform commissioning (i.e., quality control) on all energy, domestic hot water, lighting, and renewable energy systems. Review building operations within 10 months after substantial completion of construction.	●	
IEQc7.1: Thermal Comfort—Design Design air conditioning (HVAC) systems and building envelope to meet standards for temperature, humidity, and airflow.	●	

FIGURE 2: Relationship between LEED credits and co-benefits to health and the built environment

Evidence of Green Building's Influence on Community Health

Green building design tools like LEED® (Leadership in Energy and Environmental Design) could be used as levers to incorporate place-based health considerations into a building design project. However, LEED does not currently provide guidance on:

a) how to identify the place-based health needs of a development project; or,

b) which credits would be most likely to alleviate those health needs.

A structured literature review was performed by the author to identify evidence of associations between green building strategies (as defined by LEED) and the adverse health effects of two climatic events: heat waves and flooding. The analysis identified 13 LEED for New Construction credits with the potential to reduce the risk of negative health outcomes after exposure to a heat wave; and 12 LEED for New Construction credits with the same potential for flooding (Figure 1). While most of the credits fell in the Sustainable Sites section of LEED, only the Materials and Resources category was not represented in the final list of relevant credits.

The literature review assessed the strength of the evidence supporting the hypothesis that the green building practices used to achieve a LEED credit requirement could reduce the adverse effects of climate change and/or enhance a building's passive survivability (i.e., its ability to continue to function during utility outages) (US Green Building Council, 2005). These two potential outcomes from the LEED design process directly impact two of the major environmental determinants of health associated with climatic events: population exposure and built environment exposure. The combination of these determinants influences a community's relative resilience to specific climatic events, such as extreme heat or flooding. Therefore, if a LEED credit is implemented with its potential impact on community resilience in mind, its implementation can result in co-benefits to both public health outcomes and built environment outcomes (Figure 2).

In the review of literature concerned with effects of extreme heat, the dominant environmental determinants of health were identified as: 1) the percentage of vegetation in neighborhoods with vulnerable populations; and, 2) exposure to high temperatures in urban areas. Power outages exacerbated by heat were also called out for the credits in the Energy and Atmosphere and Indoor Environmental Quality categories.

Most of the LEED credits reduced risk of exposure by reducing the urban heat island effect, a practice that was also identified as the most salient co-benefit to the built environment.

The other two co-benefits to the built environment resulted from green building practices. These were reducing the burden placed on the building's air conditioning system and reducing the burden placed on the municipal electrical grid.

Co-benefits to health included reducing population vulnerability to heat stress, reducing heat-related injuries and mortalities, and increasing passive survivability.

Spatial analysis based on the results of the literature review helped determine whether green building projects have been used in Austin, TX, and Chicago, IL, over the past decade as a tool to increase neighborhood resilience to the health and environmental effects of extreme heat and flooding.

The study results indicated that LEED projects were neither targeting green building strategies with the potential to reduce vulnerability to heat or flooding nor clustered in highly vulnerable neighborhoods in the first place.

On the contrary, they were clustered in low vulnerability neighborhoods, which are arguably less in need of the potential health co-benefits they offer to building occupants and the surrounding community.

Applying Contextual Health Data to Architectural Practice and Land Use Policy

Planning for every development project can incorporate enhancements to place-based resilience and features that encourage healthy lifestyle choices. But how are the appropriate enhancements to be selected? Three methods are contextual health data analysis, health impact assessments, and incorporating health data into land use policies.

CONTEXTUAL HEALTH DATA ANALYSIS

Contextual health data analysis refers to collecting data that will give the project team a snapshot of the health needs associated with a building site. This information generally includes demographic, socioeconomic, environmental, and behavioral metrics in addition to any health outcome data sets that are available at the neighborhood level or below. If the ultimate occupants are not expected to mirror the demographic characteristics of the surrounding neighborhood then a second set of metrics should be compiled describing the health needs of the building occupants as a separate group from the surrounding community. Simply including these health metrics alongside economic, environmental, and other project goals during the conceptualization or visioning phase can be enough to influence design decisions further on in the project delivery process. However, if the project team includes a public health consultant, the contextual health data can be prioritized using analysis techniques such as correlation analysis, spatial analysis, or developing a health index of the most significant indicators.

HEALTH IMPACT ASSESSMENTS (HIAS)

Health Impact Assessments (or HIAs) are a useful tool for synthesizing the results of a contextual health data analysis with environmental, regulatory, and cultural data. HIAs use a six-step methodology to provide unbiased, data-driven recommendations of the potential health co-benefits and co-harms associated with a proposed policy or project.

Houghton (2011) describes one way the HIA process can result in useful design recommendations. The article uses as one example a hypothetical urban infill development in central Houston that combines the renovation of existing, historic residences with new residential construction. The assessment focused on increasing resilience to climate-change-related events, but the same approach could be used to address any number of public health challenges. The recommendations coming out of the HIA were divided into four categories: surrounding infrastructure, building design, building occupants, and surrounding community.

Recommendations for the surrounding infrastructure included collecting rainwater on-site, so that the development could provide minimal water utilities to residents in the event of a natural disaster. The assessment also suggested removing existing barriers to alternative forms of transportation, which can provide a lifeline to residents during and immediately following extreme weather events.

A long list of strategies was recommended for the building design. For example, the historic buildings should be upgraded to the most recent code requirements for tornadoes, hurricanes, and flooding (including the possibility of storm surges, which could reach into central Houston under the right conditions). All housing should be fitted with storm shutters, and the residents should be trained in how to install them. Basic construction materials should be stored on-site. And, again, residents should be trained on how to make emergency structural repairs. The building roofs and site should be designed to capture and store rainwater as well as to reduce the urban heat island effect. Vegetation should complement this effort by providing shading, but also by being located to minimize the likelihood of roof damage during hurricanes and extreme precipitation events.

The recommendations for building occupants, in addition to those already mentioned, touch on both design considerations and public health interventions. For example, an emergency management plan—including options for sheltering-in-place and evacuation—should incorporate both traditional emergency preparedness considerations and recommendations for altering the built environment to facilitate sheltering-in-place. Similarly, establishing a rainwater-fed community garden on site is a green building design intervention that can take on the role of public health prevention if it is bolstered by developing a plan for distributing fresh food and filtered water to residents in the event of a natural disaster that temporarily cuts off access to traditional supply chains.

Finally, the recommendations targeted to the surrounding community focus on ways to improve the resilience of the entire neighborhood through tree planting, gully clearing, installing distributed energy and water systems, building a community garden, improving access to alternative forms of transportation, etc. Moving one step further in the direction of integrating the design into the regional emergency preparedness infrastructure, the development could also be designed to formally take on the role of a neighborhood cooling center or emergency shelter during certain types of events.

APPLICATION TO LAND USE POLICIES

Contextual health data analysis on its own or incorporated into an HIA could be a powerful tool to influence land use policies—particularly at the local and regional levels—because of its data-driven nature. For example, it could be used to prioritize implementation of large-scale interventions, such as tree planting programs.

The ways in which contextual health data analysis and HIAs will play out in the policy arena will largely depend on the political climate of a specific jurisdiction. Some communities may rely on the architectural and green building professions to make use of these new tools on their own. Others may use them to encourage projects located in vulnerable neighborhoods to incorporate specific beneficial green building strategies into their designs. Existing city programs—such as weatherization programs, community gardens, reflective and vegetative roof rebates, and on-site renewable energy rebates—could also be prioritized or incentivized in highly vulnerable neighborhoods.

This information can also provide valuable guidance for climate change planning, hazard mitigation planning, and comprehensive planning processes. Finally, it could be used as a tool to educate neighborhood associations and to galvanize community action to enhance resilience.

Conclusion

The built environment is an influential driver of both health and disease. While it can be difficult to trace a direct line between a single design feature and a single health outcome, a growing body of evidence points to the potential for design to play a more active role in supporting healthy outcomes and reducing exposure to conditions that can lead to negative health outcomes. This is particularly true for efforts to reduce the burden of chronic disease and enhance community resilience to climate change. Green building programs like LEED and sustainable land use policies can be used as tools to advance this effort, because many green strategies sit at the intersection of health and efficiency.

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