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COVID-19 Home Signposts: Current Thinking in Health & Home for Those in Need

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Abstract

The Integral Living Research (ILR) group advocates for five foundational principles in the urban housing environment: 1) privacy, 2) security, 3) access to healthy nourishment, 4) access to green space, and 5) self-efficacy enhancement through a culture of care and creativity. These principles have emerged from almost a decade of work in communities of need and are intended to guide designers working towards solutions to reduce stress and enhance health for urban families. In this paper, we examine and analyze best practices in WELL Buildings' pandemic response guide among others, within the framework of housing, specifically single-family urban housing. Here, within the 2020 pandemic, best practices for alleviating the challenges of the urban single-family home in an underserved community are considered. In this analysis, five areas of focus called "COVID-19 Home Signposts" have emerged and been given additional lenses of equity and access. We describe those inequities and consider how to improve pandemic housing health for those in at-risk communities. We identify further areas for empirical study that are urgent: 1) to promote better understanding of how home, health, and housing improvement all play a role in addressing the COVID-19 pandemic; and 2) to devise appropriate strategies for addressing the fault lines in our cities and our society.

Keywords: COVID-19 Design; Health; Underserved Families; Urban Homes; Stress

Introduction

Secure and adequate housing promotes positive health and well-being in many ways that have lasting beneficial effects arising from both the increased stability and the safety from environmental illnesses thereby offered to its inhabitants (Office of the Surgeon General (US) 2009). Long understood and recognized, the link between housing and health is significant dating back to efforts from both 18th and 19th century governance to eliminate substandard urban dwellings or slums (Office of the Surgeon General (US) 2009).

The design research lab, Integral Living Research (ILR), works to incrementally add research-based behavior-oriented solutions, routines and practices to existing single-family homes and residential shelters for families living in underserved areas with limited resources. These solutions aim to mitigate stress and improve well-being. For this research, underserved populations are those residing in "Medically Underserved Areas (MUA)" with "too few primary care providers, high infant mortality, high poverty or a high elderly population" (Health Resources & Services Administration 2018).

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The ILR research group focuses on creating solutions in the living environment for family well-being related to the following five foundational principles: 1) privacy, 2) security, 3) access to healthy nourishment, 4) access to green space, and 5) self-efficacy enhancement through a culture of care and creativity. As shown in Figure 1, these five principles improve well-being through reducing a family's existing stress and giving higher exposure to health-related assets. These principles have been identified through intensive study and problem definition in the urban environment over the past eight years. They will be described in limited detail here as they are part of larger ongoing initiatives published elsewhere (Nicholas, Michael, and Anandan 2020).

> Housing is meant to address basic human needs for shelter and security by providing protection against climatic conditions (excessive heat and cold) and unwanted intrusions… Forty years ago, John Turner made the important distinction between housing as a noun and housing as a verb (Kopec 2017b, 45; Turner and Ward 2000).

Many families experience housing at different points in our existing housing system. Some families experience substandard rentals, or family homes with no access to fresh food, green space, or other health-oriented options. Other families lose homes due to domestic violence, or lack of financial opportunity. For many families in these situations, access to stable housing eludes them and they spend time in both emergency and transitional shelter environments. Here, in response to the diverse and varied nature of the housing quality crisis, the ILR approach is to advance work in single-family urban rowhomes and shelter arenas around the targeted five principles (Figure 1) in work with community partners to identify solutions. As stated previously, the scale, context, and arenas of this work arise from field experience gathered over time in a large metropolitan area. Using a modular and community-oriented approach to the redesign of substandard housing situations the group finds in our research, we have developed a series of customizable tools and service-oriented interventions for home environments and shelters to help families, no matter their current housing situation. These solutions are behavior-oriented adjustments to spaces and include portable organizational bags that convert to privacy screens, small-scale organic plant-growing units for healthy eating habits, modular aging in place solutions, and resources for renters whose housing is in need of adjustment and repair. In the ILR

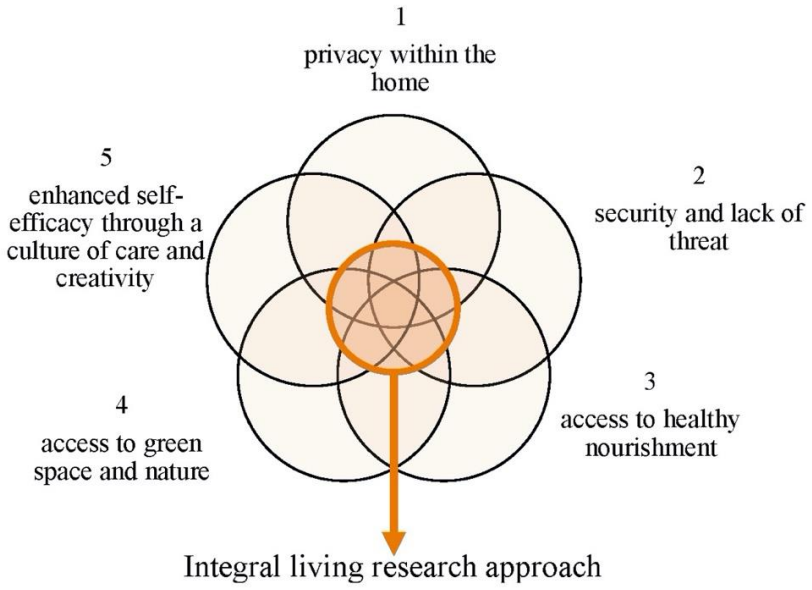


Figure 1: Integral Living Research Five Foundational Principles advocated for in healthy urban family living

Lab, architects and designers engage with scientists and epidemiologists to collaborate inter-professionally to develop these solutions through research, iterative prototyping, and development.

This paper will lay out the foundation specifically for single-family homes as a component of our home environment profile which is evolving due to the current concurrent crises of the COVID-19 pandemic, economic recession, and systemic racism. This paper examines the WELL Building Standard currently in use as a guide for understanding and improving the health of underserved families in single-family homes in this time of crisis, with an eye towards equity and access. The end goal for this paper is to create a conceptual framework that can guide future empirical study of underserved single-family homes and the part these physical environments play in health, especially considering the multiple global crises.

Stress and Well-being relating to home pre-COVID-19

Prior to the current crises, wellness relied on minimizing illness possibility through combined social, environmental, emotional, physical, mental, and spiritual health (Coles and Millman 2013, 30). An *Interconnected Model of Well-Being* proposed in the chapter "Modelling Well-Being and The Relationship Between Individuals and Their Environments" by Warber et al. (2013) links the physical environment, the mental state, and the community to an individual's overall well-being. "Through five dimensions of existence: spiritual, mental, emotional, social, and physical, well-being can be operationalized (Warber et al. 2013)." This model of well-being directly links mental health to the built environment in direct alignment with the type of behavior-oriented interventions that the Five ILR Foundational Research Principles attempt to advocate.

Many interior designers and architects are trained to understand that a safe and stable living space can create positive outcomes within the health and well-being of families. Stable housing gives residents the access and independence necessary to maintain whole-family well-being, especially in times of stress (Centers for Disease Control and Prevention 2006). This is amplified by the eight dimensions of wellness identified by the Federal Substance Abuse and Mental Health Services Administration (SAMHSA): Emotional,

Table 1: The SAMHSA eight dimensions of wellness directly quoted from "Substance Abuse and Mental Health Services Administration: Eight Dimensions of Wellness" (Lim 2015)

Emotional	Coping effectively with life and creating satisfying relationships
Environmental	Good health by occupying pleasant, stimulating environments that support well-being
Financial	Satisfaction with current and future financial situations
Occupational	Personal satisfaction and enrichment from one's work
Social	Developing a sense of connection, belonging, and a well-developed support system
Spiritual	Expanding a sense of purpose and meaning in life
Intellectual	Recognizing creative abilities and finding ways to expand knowledge and skills
Physical	Recognizing the need for physical activity, healthy foods, and sleep

Intellectual, Physical, Environmental, Financial, Occupational, Social, and Spiritual (Lim 2015). Table 1 gives more detail on each of these dimensions.

Connecting these principles to housing emphasizes that the "safe haven" of adequate housing has additional psycho-social benefits to residents (Abrams et al. 2012, 172). These dimensions define the areas in which a person must maintain consistency in order to have a positive well-being profile. These dimensions become harder to maintain if your home is not stable, secure, and free of major issues. Inherent in the SAMHSA approach is the idea that physical space will support these dimensions in some way.

An even more home-centered set of guidelines can be found through The Center for Disease Control (CDC). The CDC explicitly identifies the psychological and physical aspects of home required to maintain an individual's health. Of high importance within the CDC recommendations is the ability to support the home, be part of a community, have security, support the family life, and for the home to satisfy dwellers from an aesthetic standpoint. The CDC defined the following psychological needs to be met by healthy housing:

1. adequate privacy for the individual;
2. opportunities for normal family life;
3. opportunities for normal community life;
4. facilities that make possible the performance of household tasks without undue physical and mental fatigue;
5. facilities for maintenance of cleanliness of the dwelling and of the person;
6. possibilities for aesthetic satisfaction in the home and its surroundings;
7. concordance with prevailing social standards of the local community

(Centers for Disease Control and Prevention 2006).

The psychological essentials for people of need, in particular, are striking in scope; however, it is clear that these needs could be at least partially addressed through enhancing housing. As the main site of everyday life, the home by default drives and contains many of the principles laid out above by the CDC and SAHMSA. The impacts of healthy housing can touch every part of family life and health (Kopec 2017b). SAHMSA and CDC both call for privacy within the home, security, and lack of threat. Both frameworks also acknowledge the need for healthy nourishment and pleasing aesthetics. SAHMSA and CDC also have called out the need to be able to care for oneself and one's family and for the home environment to support this need (Chanell Baylor 2014; Centers for Disease Control and Prevention 2006; Center for Disease Control 2020). The culture of self and family care directly validates ILR's foundational principle 5: Enhanced self-efficacy through a culture of care and creativity as an important driver of healthy living and healthy housing.

Thus, both the CDC and SAMHSA, based on their established frameworks, point to a need for focus on the very topics that the five ILR foundational principles propose as a framework for action in the urban single-family home: 1) privacy within the home, 2) security and lack of threat, 3) access to healthy nourishment, 4) access to green space and nature, and 5) enhanced self-efficacy through a culture of care and creativity. From here, we can begin to strategically explore these five foundational principles through a COVID-19 lens.

Home, WELL Building & COVID-19

The ILR Lab maintains that our domestic space is a health care site whether it be a house or a shelter; the COVID-19 Pandemic health crisis has created situations in which this is now literally the case (Harvard T.H. Chan School of Public Health 2020; Matt Mullenweg 2020). Now that home is overtly utilized as a site for health and for work, the time is ripe to understand how the WELL Building Standard can augment single-family homes through a lens of health. WELL acts as a guideline for measuring and certifying health strategies in commercial, institutional, and multi-family residential buildings (Allen 2015; Clear 2018). The WELL version two (v2) standard operates through the application of ten concept areas: Air, Water, Nourishment, Light, Movement, Thermal Comfort, Sound, Materials, Mind, and Community (International WELL Building Institute 2020a). Each area is assessed through pre-conditions and optimizations for a total of 110 points to earn a level of the standard classified as one of the following: WELL Silver Certification: 50 points; WELL Gold Certification: 60 points; WELL Platinum Certification: 80 points (International WELL Building Institute 2020a).

Currently the WELL Building Standard measures user comfort in the Comfort Concept. In this concept, user comfort is satisfied through accessible design, ergonomic design, reducing intrusion of sound, reducing internal noise, regulating thermal comfort, and regulating olfactory comfort (IWBI 2018a). The Mind Concept is more closely related to stress, measuring health and wellness awareness, integrative design, post occupancy survey outcomes, beauty and biophilia, adaptable spaces, healthy sleep policies, travel policies, health policies, workplace family support, self-monitoring, stress and addiction treatment, altruism, material transparency, organizational transparency, building beauty, health through housing equity, and education space provisions (IWBI 2018b). For a workplace or a larger residential application, these metrics are an efficacious measure of how the physical and administrative features of a building can lead to improved health through mental comfort and satisfaction for large groups of users. Stress and soothing are mentioned specifically in the following sections under the Mind Concept: biophilia, adaptable spaces, building beauty, and health through housing equity (IWBI 2018b).

Each of the COVID-19 strategies relate in some way to creating and deploying solutions to maintain lower levels of stress within buildings; some strategies outlined in the WELL Building Standard lend themselves to portable or service-oriented solutions at the scale of the home. The "Health and Wellness Awareness" Feature of the WELL Building Standard under the Mind Concept calls for building users to be educated in healthy behaviors and options, while the "Post-Occupancy Surveys" and "Integrative Design" Features prescribe methods that design teams can undertake to ensure buildings are designed and adjusted to better support health. In the existing single-family home, these measures are a challenge because the home is significantly smaller compared to the spaces that WELL usually measures, making it a challenge to translate some of the larger spatial concepts of this standard to the single-family home environment.

2020 has been a historic year and many of the organizations that guide the building industry in terms of sustainability and health have prepared and published guidelines based on the science of COVID-19 transmission and spread. WELL recently put out a white paper guide authored by 16 experts with input

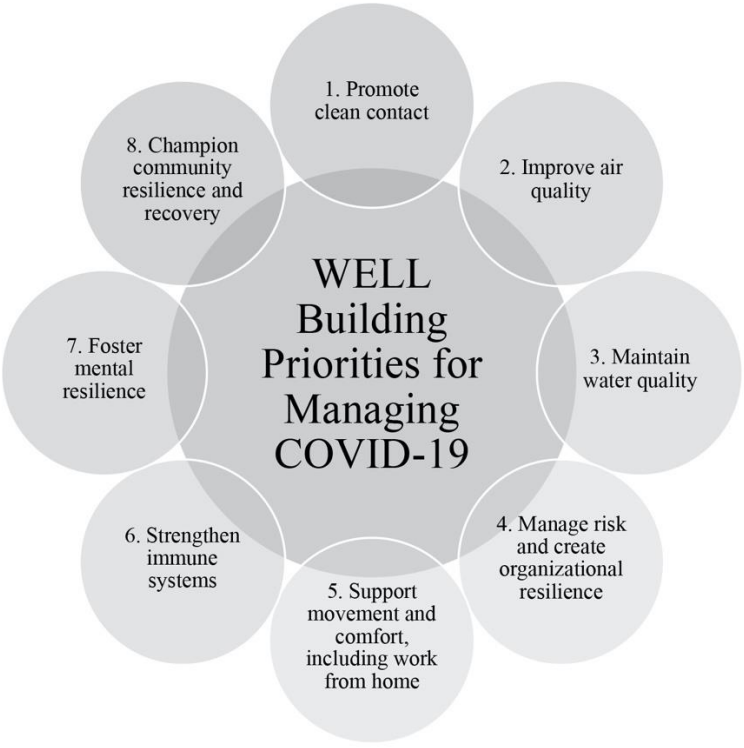


Figure 2: WELL Building Standard COVID-19 Task Force white paper main recommendation areas for managing COVID-19 (International WELL Building Institute 2020b)

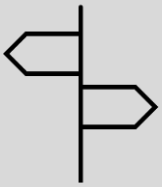
from over 500 other experts in health and built environment work. All eight of the recommended WELL categories from the white paper are summarized and shown in figure 2 above. The guide calls attention to the relevant aspects of the newest published version of the v2 standard that best support teams designing with COVID-19 in mind (International WELL Building Institute 2020b).

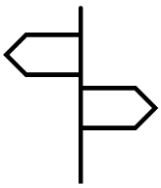
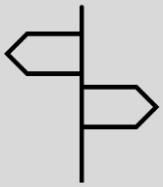
The main goals of the WELL white paper are to:

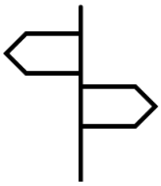
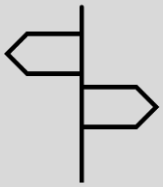
- Inform new Guidelines for Prevention and Preparedness, Resilience and Recovery for individuals, organizations and communities to help them better integrate actionable insights and proven strategies into how they manage both their buildings and their organizations (International WELL Building Institute 2020b, p. 3).
- Assess ways in which the WELL Building Standard can be further strengthened in this moment and also into the future, reflecting any new research and incorporating evidence-backed strategies that have evolved in response to the COVID-19 pandemic. (International WELL Building Institute 2020b, p. 3)

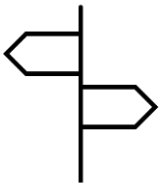
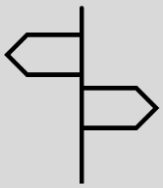
To this white paper and the most recent version of WELL, the authors here seek to add an additional layer identifying specific challenges for underserved urban families to stay healthy and protected at home during the COVID-19 crisis. Recommended concepts and categories that were relevant to housing proposed in the white paper, are summarized in detail in Table 2, and aligned with the 5 ILR home signposts for urban families.

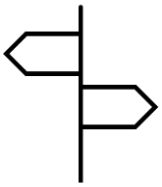
Table 2: Relevant excerpted recommendations for urban families: this table correlates the Well COVID report recommendations through relevant extensive quotes from International WELL Building Institute COVID-19 recommendations (International WELL Building Institute 2020b) and aligns them with the ILR Five Principles.

WELL **White paper recommendations for COVID-19** **Aligned with ILR Home Signposts**	**Recommended WELL Features** **(direct quotes from** International WELL Building Institute 2020b)	**Relevant ILR** **Foundational Principle**
1. Promote clean contact **COVID-19**  **Home Signpost 3: Contamination** **Home Signpost 4: Nourishment**	**GOAL: Reduce exposure** **Reduce exposure to pathogens, allergens and hazardous cleaning chemicals:** **Handwashing – <u>WELL Feature W08</u>** Reduce pathogen transmission associated with washing and drying hands by providing sufficiently large sinks, disposable soap containers and hand-drying towels. **Cleaning Products & Protocol – <u>WELL Feature X09</u>** Implement a rigorous cleaning protocol that addresses high-touch surfaces, provide annual trainings, maintain cleaning logs and restrict use of hazardous or harmful ingredients in cleaning, disinfection and sanitization products.	**Security**

2. Improve air quality **COVID-19**  **Home Signpost 3: Contamination** **Home Signpost 4: Nourishment**	**GOAL: Reduce indoor air quality issues** **Ventilation Effectiveness – WELL Feature A03** Bring in fresh air from the outside through mechanical and/or natural means to dilute human and product-generated air pollutants. **Enhanced Ventilation – WELL Feature A06** Implement advanced ventilation strategies such as increased outdoor air supply, demand-control ventilation, displacement ventilation and advanced air distribution that can enhance air quality**.** **Operable Windows – WELL Feature A07** Provide operable windows and encourage building users to open windows when outdoor air quality is acceptable. **Air Filtration – WELL Feature A12** Implement adequate air filtration and document a maintenance protocol for installed filters. **Microbe and Mold Control - WELL Feature A14** Implement ultraviolet air treatment. **Moisture Management – WELL Feature W07** Implement design strategies to limit moisture accumulation and the potential of mold growth from water infiltration and condensation within buildings. **Humidity Control – WELL Feature T07** Limit the growth of pathogens and maintain relative humidity levels that are conducive to human health and well-being.	**Security**
3. Maintain water quality **COVID-19 Home**  **Home Signpost 3: Contamination** **Home Signpost 4: Nourishment**	**GOAL: Reduce exposure to water contaminants and opportunity for water to spread disease** **Fundamental Water Quality – WELL Feature W01** Meet performance thresholds for turbidity and coliforms for all water likely to come in contact with building occupants. **Water Contaminants – WELL Feature W02** Provide drinking water that meets performance thresholds. **Enhanced Water Quality – WELL Feature W04** Provide drinking water that meets performance thresholds. **Water Quality Consistency - WELL Feature W05** Filter drinking water and perform quarterly water quality tests.	**Nourishment, Security**

4. Manage risk and create organizational resilience **COVID-19**  **Home Signpost 2: Risk and Preparedness**	**GOAL: Reduce exposure through preparedness** **<u>WELL Feature C15</u>** Develop an emergency management plan and supporting resources. **<u>WELL Feature C10</u>** Enable working parents and caregivers to care for members of their family. **<u>WELL Feature C03</u>** Establish minimum standards for the evaluation of occupant experience, health and well-being. Enhanced Occupant Survey. **<u>WELL Feature C04</u>** Collect and respond to in-depth feedback from building users on their comfort, satisfaction, behavior, health and other robust factors related to their well-being, both before and during occupancy.	**Privacy, Security, and Self-Efficacy**
5. Support movement and comfort, including work from home **COVID-19**  **Home Signpost 1: Home and Space**	**GOAL: Health Promotion through physical ergonomics and movement** **Visual and Physical Ergonomics – <u>WELL Feature V02</u>** Reduce physical strain and injury as well as improve comfort, safety and general well-being through ergonomic design and education. **Active Furnishings – <u>WELL Feature V07</u>** Discourage prolonged sitting and sedentary behaviors by providing active workstations and furnishings. **Enhanced Ergonomics – <u>WELL Feature V10</u>** Collaborate with a qualified professional to audit ergonomic conditions and provide recommendations for improvement. **Self-Monitoring – <u>WELL Feature V12</u>** Provide occupants access to wearables that can monitor individual physical activity metrics.	**Privacy, Security, and Self-Efficacy**

6. Strengthen immune systems **COVID-19 Home**  **Home Signpost 3: Contamination Reduction** **Home Signpost 4: Nourishment**	**GOAL: Health promotion through a culture of health and overall well being** **Health Services and Benefits – <u>WELL Feature C05</u>** Provide access to essential health services, screenings and assessments. Mental Health Support – **<u>WELL Feature M03</u>** Increase availability of and access to mental health support services and care. **<u>WELL Feature C06</u>** Cultivate a culture of health through various health promotion strategies, including regular communications, stakeholder involvement and health risk assessments. **Mitigate the risks of smoking: Smoke-free Environment - <u>WELL Feature A02</u>** Deter smoking, minimize occupant exposure to secondhand smoke and reduce smoke pollution. **Tobacco Prevention and Cessation** **<u>WELL Feature M13</u>** Provide access to tobacco cessation support programs and promote prevention by providing education on the health consequences of tobacco use. **Stay nourished, active, and hydrated: Fruits and Vegetables - <u>WELL Feature N01</u>** Promote the consumption of fruits and vegetables by making them easily accessible. **Drinking Water Promotion <u>-WELL Feature W06</u>** Promote hydration by making high-quality drinking water readily available.	**Nourishment, Self-Efficacy**
7. Foster mental resilience **COVID-19**  **Home Signpost 5: Mental Health and Stress and Signpost 3 Contamination Reduction**	**GOAL: Enhanced over-all well-being through mental health** **Mental Health Promotion** **<u>WELL Feature M01</u>** Promote mental health and well-being through a commitment to mental health education, programming and initiatives. **Mental Health Education** **<u>WELL Feature M04</u>** Promote mental health awareness and support by making mental health education and training available. **Stress Support** **<u>WELL Feature M05</u>** Identify and mitigate sources of workplace stress and provide programs that support stress management. **Restorative Opportunities** **<u>WELL Feature M06</u>** Create opportunities for mental recovery and restoration by providing micro- and macro-breaks from the workplace.	**Self-Efficacy, Nourishment, Security**

7. Foster mental resilience (con't)	**Access to Nature - <u>WELL Feature M02</u>** Incorporate nature into the design of interior and exterior spaces by integrating plants, water, light and views, as well as natural materials, patterns, colors or images. **Enhanced Access to Nature - <u>WELL Feature M09</u>** Provide enhanced access to plants, water and natural views. **Light Exposure and Education – <u>WELL Feature L01</u>** Provide appropriate light exposure in indoor environments by using daylighting or electric lighting strategies, and provide education about the importance of light for health. **Enhanced Daylight Access – <u>WELL Feature L05</u>** Integrate daylight into indoor environments and provide windows with views outside.	**Self-Efficacy, Nourishment, Security**
8. Champion community resilience and recovery **COVID-19**  **Home** **Signpost 5: Mental Health and Stress**	**GOAL: Health Promotion through community Civic Engagement <u>WELL Feature C11</u>** Encourage the creation of opportunities for individuals to become actively involved in and connected to the surrounding community through engagement and volunteerism. **Community Access and Engagement <u>WELL Feature C16</u>** Create opportunities for community members to connect and collaborate. **Provide access to localized food sources: Food Production - <u>WELL Feature N12</u>** Improve access to fresh produce and provide opportunities for on-site food production. **Local Food Environment - <u>WELL Feature N13</u>** Support healthy food access and reduce environmental barriers to healthy eating.	**Self-Efficacy, Nourishment, Security**

In the current time of crisis, including the pandemic, global recession, and US social injustice and racism, stress is at an all-time high for families living in underserved areas (CDC 2020a; 2020b). As previously reviewed, the ILR Lab's foundational principles serve as a basis for concentrating and prioritizing critical issues in the home related to reducing stress for families. Here we build upon these principles when shifting the lens to COVID-19. Table 2 highlights how the five principles support concepts as identified in the WELL Building Standard. In addition, we identify the five COVID-19 "Home Signposts" we developed relating to the home environment and the current pandemic and social crises. Each of these Signposts grew from the WELL COVID-19 recommendations, as well as from CDC and Fitwel guidelines addressing how homes might support stress reduction during these concurrent crises. These "Home Signposts" include Signpost

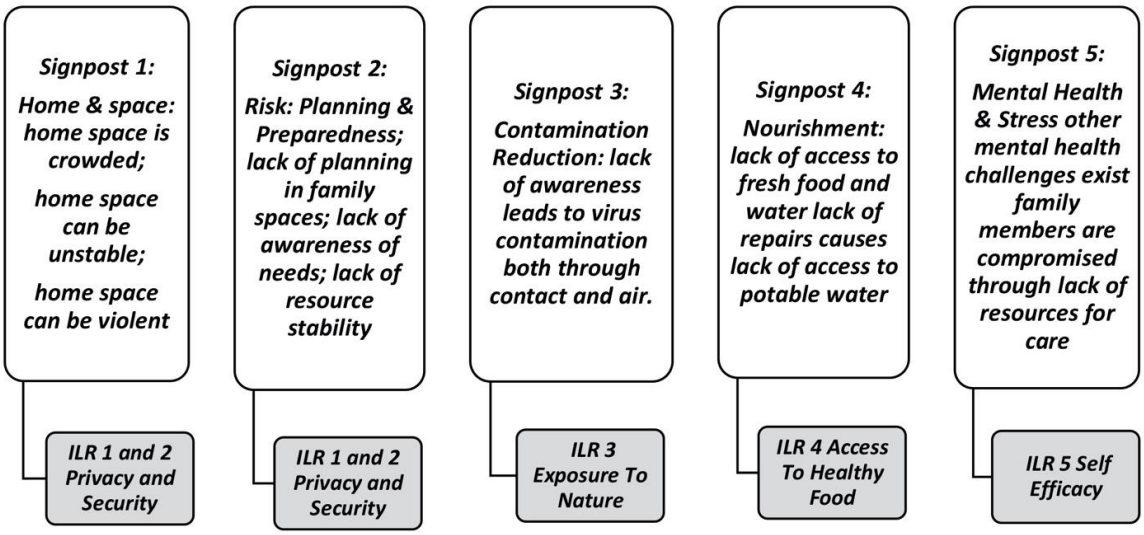


Figure 3: The Five COVID-19 Home signposts developed from the WELL Building Standard COVID-19 recommendation Task Force (2020), and Five ILR Foundational Principles related to each of them.

1: Home and Space; Signpost 2: Risk: Planning and Preparedness; Signpost 3: Contamination Reduction; Signpost 4: Nourishment; and Signpost 5: Mental Health and Stress. Figure 3 correlates these signposts to the ILR five foundational principles for reference.

These Signposts identify areas that require attention and must be prioritized within the home; they also help organize the different recommendations and research emerging from stakeholders. Areas of equity and access are foregrounded in these Signposts, not as a criticism to the existing work being done, but to provide direction for future research. The following sections break down the considerations and inclusions for each of the five Signposts.

COVID-19 Home Signpost 1: Home and Space

For those with jobs that allow them to follow the advice to stay home to work, the WELL Building Standard white paper contains recommendations for health within the home-and-work space. However, many in underserved populations find their work situations do not allow for them to work from home. As such, these populations are subjected to constant possible exposure to the illness and unavoidable exposure for their families (Donald Moore 2020). For many in underserved communities, their inability to avoid exposure leads to the subsequent cascade of illness that COVID-19 has visited on these communities at a disproportionately higher rate than in other population groups. (Vesoulis 2020; Fisher and Bubola 2020).

Fitwel and The Center for Active Design (CAD) have published a series of white papers as five chapters, entitled Research to Action: Building Health for All® in the face of COVID-19, that synthesize current public health information, residential space, and COVID-19. This resource provides valuable information which acknowledges the challenges that the residential environment faces as a dual location for work, specifically in urban underserved neighborhoods, and highlights the disparities encountered by minority groups as a result of these urban environments (Fitwel 2020). Fitwel and CAD are at the forefront of this changing landscape with constantly updated resources and with a remarkable ability to inculcate equitable information beyond much of what other organizations have been able to synthesize in their advisory efforts. In marked contrast, many building-centric and space-centric guides that address matters pertaining to the urban residential environments do not discuss the rise of intimate partner violence during the pandemic (Taub 2020).

Fitwel's work-from-home guidelines call for a safe space where one can work remotely. The recommendations include connecting with nature as much as possible by working near a window or creating a biophilic area with houseplants; prioritizing daylighting; trying to spend time outside during the work-from-

home day; cleaning; shading one's space; establishing cleaning routines; and ventilating the home (Fitwel 2020). The combination of stress, lack of space, and, now, the increased instances of violence in the home of many exacerbate the urban health risks associated with home spaces for urban populations. The emerging nature of this pandemic and climate highlights how much empirical work is still needed on the nature and relationship of violence, stress, space, and health for underserved families.

COVID-19 Home Signpost 2: Risk and Preparedness

The second COVID-19 Home Signpost is concerned with how families prepare for large crises. Families that live in earthquake or hurricane zones may have a basic level of preparedness including things like bottled water, batteries, and candles. A place of business or a multi-family dwelling are far more likely to have a more robust preparedness for disasters and crises than a single-family home due to the inherent systems of liability built into many places of business, such as fire prevention or protection. Even though the media heighten our awareness of risk preparedness through movements such as preppers, it still does not occur to the average family to be overly prepared for a disaster or crisis (FEMA 2020a). Awareness levels about disaster preparedness are increasing commercially with the advent of consumer products as services, such as Nest home alarms and smart refrigerators that track your groceries, and the service economy in general. The preparedness area is scaling into the single-family home through social media and technology, one example would be a preparedness bag named Judy that texts you alerts and tips about disasters in your region (Chen 2020; Crook 2020).

For public and multifamily buildings, the WELL COVID-19 white paper recommendations call for building managers and design teams to manage risk and create organizational resiliency through a combination of occupant and building management surveys (International WELL Building Institute 2020b). In the single-family home, this could translate to a standard home assessment and emergency plan for each family. In some urban cities, there are urban health nonprofits, such as The National Nurse-Led Care Consortium in Philadelphia, PA, that will inspect residents' homes for such issues as lead paint, repairs, leaks, and other dangerous conditions related to asthma and injury (Gero 2020). The ILR research group believes that it would be possible to replicate home assessment on a more city-wide scale and create a standardized home report that includes guidelines enabling families to undertake emergency planning, and preparedness.

Government resources include a disaster readiness site for families at Ready.gov with tips and materials to consider in disaster preparedness (FEMA 2020b). It is without doubt that the average family will consider such materials and thereby be more prepared for future crises; however, families that are under chronic stress and have substandard housing conditions may be unable – mentally or physically – to prepare for such exigencies. Thus, in order to consistently consider preparedness, the recommendation made by this group is to attach this type of planning to another existing, extensively used service.

Security

The ability to control personal spaces often relates to individual feelings of privacy and security when occupying those spaces. Averill's theories of control in environmental social science and psychology touch on three main areas of control: behavioral control, cognitive control, and decisional control (Kopec 2012, 22). Overcrowded or unstable spaces interfere with these areas of human control and our ability to maintain a feeling of privacy or security within that space. When not addressed properly by the environment, the lack of privacy can lead to a sense of perceived helplessness for those living in, working in, or otherwise using a building (Kopec 2012, 22). This helplessness can cause residents to question their future, their livelihoods, and the very stability within their lives. In turn, this instability creates a threat to resident health which can be compounded through an additional risk of losing one's housing (Marcus 1995). Our group is creating and testing tools to help residents stay in their home, to ameliorate the stress of housing insecurity at the source, and to help build self-efficacy. While empirical data is being gathered, the constant design process has identified the needs of populations in these stressful situations (Nicholas and Michael 2017). Within the path to resident preparedness, both planning and stability play a major role. How these concepts become integrated into the concept and operation of home for underserved populations requires further study.

COVID-19 Home Signpost 3: Contamination
Promote Clean Contact: Public Health Best Practices

The third COVID-19 Home Signpost is also concerned with the ability of families to adopt public health best practices related to reducing risk from infection. While the world has only had a few months to learn about COVID-19, evidence has been found to support practices to mitigate the spread and impact of this novel virus, thus reducing illness and death. For the purpose of this paper, the practices fall into two main areas: personal measures, and physical and social distancing. Personal measures aim to protect individuals and their person-to-person contacts while reducing contamination of frequently touched surfaces. The World Health Organization and the CDC have identified and recommend a number of personal measures including: 20-second hand washing, respiratory etiquette based on the use of masks covering the nose and mouth, and environmental cleaning and disinfection at home (CDC 2020d; World Health Organization 2020b). The CDC also provides further details regarding cleaning with soap and water to reduce the number of germs, dirt and impurities on surfaces in the home environment, as well as disinfecting surfaces after cleaning with an EPA-registered household disinfectant to kill any additional germs (CDC 2020c). Recommended physical and social distancing measures in public spaces are intended to reduce crowding in those places. These recommendations include limiting access to, or closing non-essential businesses, schools, and other public spaces. Large or mass gatherings such as conferences should be adapted for the virtual space, postponed, or canceled.

As an example, Johns Hopkins University had adopted these public health strategies early in the pandemic based on a hierarchy of control measures. These measures range from the most effective to the least effective for controlling exposure to the virus, based on CDC guidance (Choi and Health n.d.). The most effective strategies are those that eliminate risk through social isolation. For individuals, this means eliminating unnecessary trips to the store and working from home when feasible. Social isolation includes staying home if sick or suspect exposure. Less effective are administrative controls, described as "changing the way work is performed," including routine practices at home. These include daily disinfection of spaces including homes, and physical and social distancing measures for workplaces and schools. Failure to use masks and other Personal Protective equipment properly renders them low in effectiveness, and social distancing guidelines are essentially worthless when people fail to adhere to them, deliberately or otherwise. To be an effective measure, adequate supplies of PPE must be available, and they must be used properly and continuously — and this has been of varying ability to achieve throughout the Pandemic based on compliance and availability.

The WELL Building Standard recommendations around cleaning and clean contact are tuned to larger environments. The CDC and WHO both recommend enhanced cleaning regimens for commercial facilities and homes (World Health Organization 2020a). It is essential to have adequate handwashing stations, e.g., sinks, soap, and hand-drying towels, inside homes. Additionally, it is important to make it easy for residents to clean high touch surfaces and to encourage the use of low toxicity cleaning products. Residents living in urban homes that lack adequate water supply and need repair will face major challenges in implementing cleaning protocols and enhanced hand washing. Many urban underserved families live in homes in disrepair where potable water may also be an issue, leading to the inability to wash hands properly and thus encouraging the spread of COVID-19. This limitation is taking place both in America and globally (Corburn et al. 2020; IWA 2020; Du, King, and Chanchani 2020; Ungar and Lucas 2020).

Air and Ventilation

To help mitigate COVID-19, the WELL Building Standard advises that buildings increase ventilation, especially from the outside. This part of the WELL standard also calls for increased air refresh rates to reduce contaminants. Reduction of pathogens is also served through increased humidity control and monitoring. Many of the ventilation schemes called for in the WELL standard, including "Implement advanced ventilation strategies such as increased outdoor air supply, demand-control ventilation, displacement ventilation, and advanced air distribution that can enhance air quality (International WELL Building Institute 2020)" are not feasible in underserved single-family households with limited means. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and The Center for Disease Control (CDC) also supply guidance for air control in single-family homes, with the CDC guidance directing to the ASHRAE guidance page. Additional advice from the CDC consists of steps that many families would easily find achievable:

> Open the windows, or screened doors, if possible; Operate a window air conditioner that has an outdoor air intake or vent, with the vent open (some window air conditioners do not have outside air intakes); Open the outside air intake of the HVAC system, if yours has one (this is not common); Consult your HVAC manual or an HVAC professional for details; Operate a bathroom fan when the bathroom is in use and continuously, if possible. (CDC 2020b)

In more extreme situations of home disrepair or insufficient housing, families may find themselves unable to properly ventilate the spaces they inhabit. They may also be unable to isolate those persons who may be infected with COVID-19, as recommended (CDC 2020b). Researchers are currently studying internal home pollution and the role it may play in the severity of a COVID-19 infection, but it is clear that many residents of substandard housing are unable to properly ventilate their spaces, or to create a separate zone of ventilation for those too ill to be isolated (Harvard T.H. Chan School of Public Health 2020; Huong and Nicholas R. Jones 2020; Fisher and Bubola 2020; Vesoulis 2020).

The ILR foundational principle most related to contamination is the principle calling for exposure to green space. Research shows that humans must have access, both visually and physically, to green space and nature to be healthy. During the pandemic, several studies have shown that in Europe urban citizens have increased their incidence of visits to local greenspaces in spite of or perhaps because of lockdown restrictions, these studies indicate a need for respite through nature (Day 2020; Ugolini et al. 2020). Humans' basic need for nature is called biophilia; when satisfied, it is linked to lower stress and agitation levels (Wilson 1984, 1). Nature's ability to help humans is also addressed by a theory called the attention restoration theory which holds that nature plays a role in how humans can recover from stress and trauma (Kaplan 1995); the literature also supports a crucial role for nature and healing (Sara Warber et al. 2013). For example, children who lived in rural areas and neighborhoods with access to green space had a reduced risk of attention-deficit/hyperactivity disorder (ADHD), a common neurological disorder in children (Donovan et al. 2019). Exposure to nature has always been central to our health and wellbeing, and now during this pandemic lockdown, nature exposure is a proven corrective to the load that increased levels of confinement in indoor spaces is placing on our health.

Urban underserved families have less access to plants and green space. Many in urban areas are unable to take advantage of the stress-lowering benefits of daily routines involving plants and nature (Sara Warber et al. 2013). The COVID-19 pandemic has reinforced this need for easily accessible stress and contamination reduction through nature, as even those with limited exposure to nature are shut in their homes indefinitely (Maddock, Kash, and Keys 2020). Strategies for designers to inculcate true biophilia into future designs is under study, though incorporating actual plants serves this purpose as well (Terrapin Bright Green 2014). In single-family homes where access to nature and green space is limited, urban families face a unique challenge that must be examined at length if housing is to be equitable, and for health supportive-strategies to be employed.

COVID-19 Home Signpost 4: Nourishment

The ILR foundation principle of Access to Healthy Food emerged as a result of the ILR Lab interacting with community partners and has since been substantiated by literature and reinforced through the emergence of the COVID-19 pandemic. Urban, underserved families may have limited access to nourishment, especially fresh food, due to poor access to quality grocery stores and inadequate financial resources for purchasing food (Kern et al. 2017). Access to beneficial community environments – environments supportive of healthy eating (Kirk et al. 2010; Saelens et al. 2012) – is unequally distributed in many underserved areas (Kumanyika, 2008), with minority adults and children less likely to live in neighborhoods that supply access to healthy food (Day and Pearce, 2011; Kipke et al. 2007). Contributing to this inequity is the fact that urban food merchandising strategies are unhealthful and the increased cost of bringing fresh food into urban areas is often passed to the customer (Kern et al. 2017). Around 23.5 million Americans live in food deserts, which are areas where a store selling food is not within five miles (Food Empowerment Project 2020; Southern Poverty Law Center 1991). This lack of access to healthy food is exacerbated even further during the pandemic; supply chain issues have been rife in urban areas (Caldwell 2020).

A survey was conducted addressing healthy food access among Philadelphia residents living in a

designated Promise Neighborhood identified as a food desert. Results show a pattern of fruit and vegetable consumption that is more complex than the neighborhood's 'food desert' designation implies (Michael 2015). Seventy-eight percent of respondents claim to eat vegetables, either fresh or frozen, at least once a day. However, only 8% met the dietary guidelines of two to three cups a day (USDA 2012). Regarding fruit, 67% reported eating at least one serving a day, and 39% met the criteria for the recommended guidelines (USDA 2012). Although 80% of residents thought that obtaining food in general was not very difficult, 61% noted that obtaining fruits and vegetables specifically in their neighborhood was difficult. Two area supermarkets, Fresh Grocer and ShopRite, account for 63% of where residents do their food shopping. While some community gardens were available in these neighborhoods, only 12% of respondents participate in community gardening. However, 80% of respondents indicate that they would participate in a community garden if land and training were available. While that number seems high – for example, not everyone who may want to garden has the time to participate – 55% identified lack of gardening training and space for a garden as the main barriers to community garden participation. This research suggests that while healthy food in urban neighborhoods was limited, residents were open to community-based strategies, such as community gardens, to increase access (Alaimo et al. 2016).

COVID-19 Home Signpost 5: Mental Health and Stress

Literature shows that attachment to place is part of our personal identity and that maintaining our ability to live and stay in that place supports a heathy identity, and thus healthy people (Coles and Millman 2013, 21). People require control of their spaces to feel safe (Kopec 2012, 22). Overcrowding and the instability it engenders interfere in a major way with how humans experience the effects of their financial stability and physical security within the home and the contribution of those to overall levels of stress (Kopec 2012, 22). Long-term stress contributes to inflammation and reduced immune response (Morey et al. 2015). Self-efficacy is the belief in ones capacity to undertake certain tasks and achieve life goals large and small(Bandura 1977). Self-efficacy reflects confidence in the ability to exert control over one's own behavior and social environment, and is negatively affected by factors such as stress and fear about housing security (Bandura 1997). Research has shown that underserved, low-income individuals are often prevented from prioritizing self-care and house repair due to the cascade of other expenses that put them underwater relative to their incomes (Bennett 2008).

The emergence of additional stressors during the pandemic is clear. The COVID-19 pandemic-based WELL recommendations call for a culture of care in the workplace, and for mental health to be prioritized in keeping people healthy (International WELL Building Institute 2020b). This is an even bigger challenge for families whose homes are in a state of disrepair, and who must work outside of the home to maintain their level of income and livelihood. Here, in addition to the safety and environmental concerns experienced when living in an underserved home, the increased difficulty in maintaining one's sense of self-efficacy becomes a part of the overall stress profile and may have an effect on an individual's ability to recover or avoid illness such as COVID-19.

Future Possible Health Measures: The Healthy Home Pre- and Post-COVID-19

The authors have come to believe that in understanding urban health single family homes are a crucial component. We also believe that the consideration of the typical home space, it's shortcomings, the locational contexts and availabilities, and who inhabits the space together, all come to bear on how successfully healthy a family will be in their home. It is clear these issues are all amplified during the current pandemic conditions, causing health ramifications that will echo through the urban underserved neighborhoods of our major cities for a long cycle of frustrating recovery. The work described here posits that our failure to understand, advise, or assess how these elements will impact the health of those with less means could have a tandem ripple effect on the urban health costs that already burden our societies. We also believe from experience that this cost will borne by those with the fewest resources and those organizations who serve them. This next section seeks to examine how the following four topic areas might contribute to future conversations on assessment and planning for this type of space driven health understanding: space and health at home issues: human comfort in single-family homes, home assessment tools, and home environments and health outcomes.

Space and Health at home issues: Environmental psychology, or the study of behavior in space, gives

researchers a model to understand how our human psychological needs are driven by and satisfied by our spaces (Kopec 2012). How spaces are configured, and how that configuration is linked to user satisfaction through "affordances," is a well-studied topic in environmental psychology (Kopec 2012). Also well-defined and studied are the ways that stress can drive various health issues (Thoits 2010). The key metrics in assessing, or guiding design for, user satisfaction are currently focused on measuring chemical interference, thermal comfort, lighting quality, and aural comfort in each space (Leaman 2003). These metrics are undoubtedly important; however, better understanding the health of users in single-family, underserved urban environments is an area for further study, especially in trying to determine how well different strategies could enhance comfort, enhance health, and reduce stress (Kopec 2012; Thoits 2010).

Human comfort in single-family homes: Health could also be understood through a study of the related concept of human comfort in buildings. Stress and comfort are related, and comfort is currently measured mostly in terms of temperature, sound, and lighting level. The BUS Methodology, a survey tool recently acquired by Arup, takes other features such as social interplay and occupant satisfaction into account, but the methodology was developed for non-residential spaces in Britain. This BUS Methodology is most successful at measuring and understanding behavior-related comfort issues. This developed survey assessment directly evaluates the occupants' reaction to space and makes use of 30 years of accrued data from past projects to compare and validate the results. This creates a useful base, leaving room to build a more objective set of factors for measuring human comfort factors; as the data accrues, the more validity becomes possible (Arup 2020). The BUS tool primarily looks at the user's comfort in relationship to productivity and satisfaction, as well as the relationship between productivity and building performance (Arup 2020). A number of issues that BUS and other similar tools are concerned with, such as productivity, are limited in their usefulness in single-family homes. Similar to the WELL Building Standard, the BUS tool is deployed by building owners to assist with understanding how certain variables relate to thermal comfort; elements like ventilation, indoor air quality, and user control have a bearing on occupant satisfaction, building efficiency, and ultimately. possibly enhanced productivity in a workspace (Arup 2020). Measuring these types of elements inside the existing single-family urban home, in tandem with insightful qualitative data around how home space is understood in terms of stress and health, has yet to be approached from a building and design focus.

Home environments and health outcomes: To more meaningfully understand how the single- family home might be studied or measured for health, it is also relevant to understand how the health care sector might extend its reach into single-family housing. Often home and health interventions in this sector are linked to preventing the health ramifications of substandard housing. Home health surveys are now sometimes undertaken through hospitals who are trying to assist outpatients with their aftercare (Wallace et al. 2017). Many of these extended-care efforts focus on better communication between patient and caregiver. Compliance in medicine and tracking are the main goals for the patients' health outcomes after a hospital visit (Wallace et al. 2017). How the physical environment of the home might contribute to health and well-being outcomes is harder to assess and understand, due to the varied nature of home environments. Several hospitals are growing more granular on this front as they realize that the home environment can drive re-admission and hospital costs. Hospitals now are trying to understand possible relationships between re-admission, housing location, and relative housing quality; they use big data and other factors related to epidemiology to track the likelihood of patient readmission (LexisNexis 2020; Penn Medicine 2020). Empirical studies exploring relationships between the patients' home and health outcomes has great potential for further understanding how single-family homes might play a part in disease prevention.

Home assessment tools: The Home Preservation Initiative (HPI) is a research and action-oriented program for improving homes in West Philadelphia; our Lab participates as a research partner. The HPI group undertook research exploring the impact of home disrepair and neighborhood conditions on residents ' mental and physical health. In-depth interviews described a marked increase in depression due to home disrepair, in addition to the usual ill health effects of poor housing which include accidents such as falls, allergies, and asthma (Urban Health Collaborative 2019). Further work in the home space could draw on hospital or nurse-oriented home assessment tools as a starting point to meaningfully engage the single-family home. Pre-COVID 19, many tools existed to guide designers on strategies and materials for both workspaces and multi-family residential buildings.

These tools also address an array of other variables: life cycle, sustainable qualities, chemical composition, manufacturing processes, and occupant health. The list of tools includes the WELL Building Standard, The Pharos Project, Athena, LEED, Fitwel and others. Of these, the WELL Building Standard and Fitwel are the most overtly user-focused, operating at the scale of the building. There are no tools to measure or guide the design of small-scale buildings and the health outcomes within them. Future measures might include how homes and recovery times correlate based on access to fresh food, natural spaces, or adequate planning. Would certain configurations lend themselves more naturally to lower stressors or better health in a world where most families are learning, working, or spending most of their time together? How will these questions be studied in the future and what are the benefits of this type of study?

Conclusion

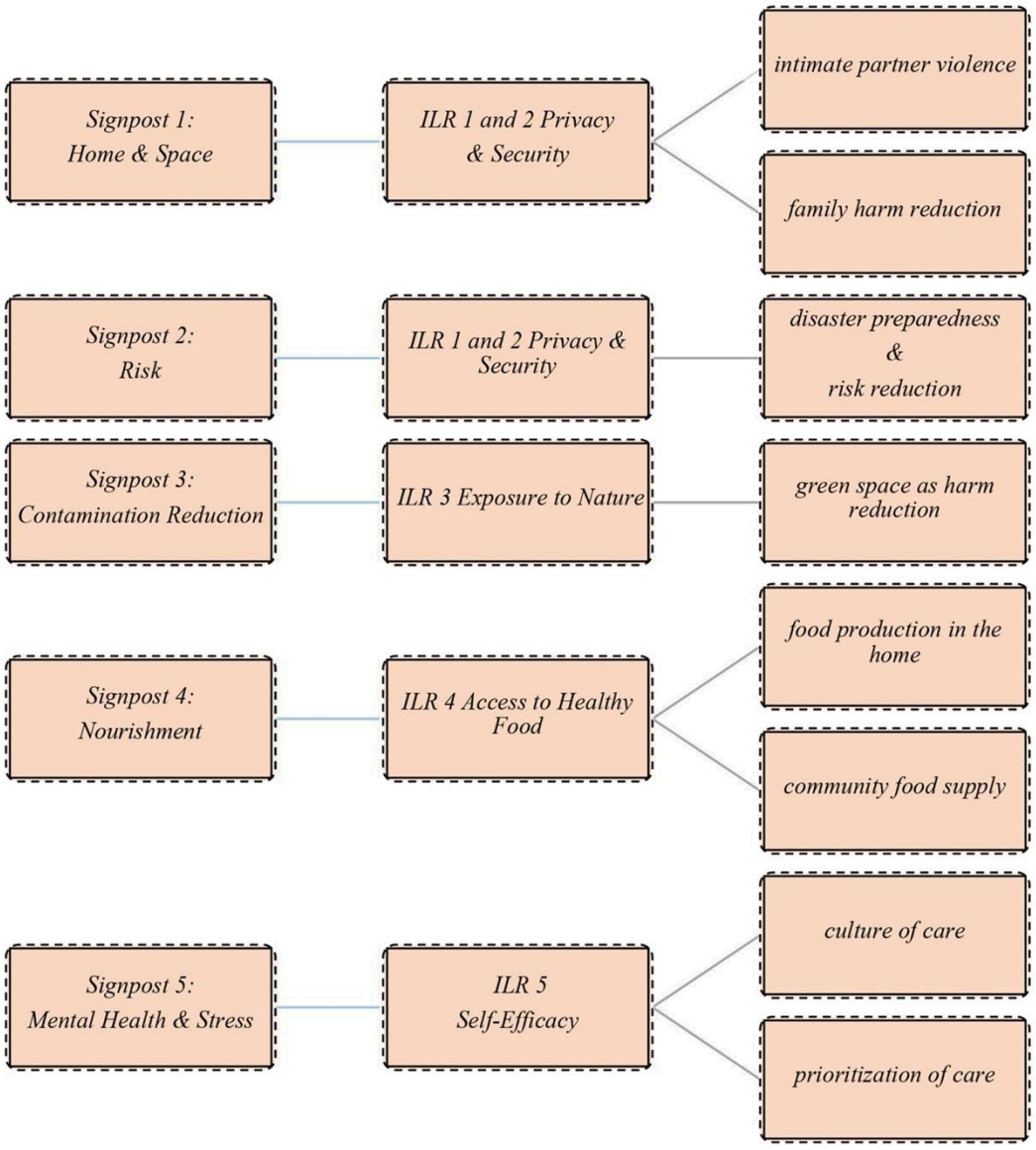


Figure 4: The Five COVID-19 Home signposts, correlated with the Five ILR foundational principles and the areas identified for attention within each.

The home is the source of an individual's comfort and security, and our ability to control this environment, and optimize it for our use, is part of what makes us who we are (Allen 2015). The COVID-19 pandemic, coupled with the mental and emotional stress that this year has uncovered, has created much urgency in the area of single-family home and housing improvement. As those in building science research know, buildings are a collection of manufactured objects. As such, each component of a building also has the possibility to have an effect on the health of inhabitants.

We now know that well-being is defined as a more encompassing measure of human health, linking the environment, psychological well-being, and health (Kopec 2017a). As defined in Lynne Dearborn's chapter "Traditional and Alternative Approaches to Health and Well-being" in Dak Kopec's recent reader *Health and Well-Being in Interior Architecture*, well-being relates to the combination of mind and body and is driven by environments that satisfy our needs, creativity, and senses (Kopec 2017a, 28). Part and parcel of the mind and body connection is the association between spaces that set the mind at ease and contribute to an improved state of wellness (Sternberg 2009, Kindle Loc. 112-114). The physical arrangements of our living spaces influence our health as much as the chemical makeup. The ILR research group advocates for five foundational principles within the home listed below in Figure 4. In addition, through our analysis of the existing pandemic white-papers, we have identified five correlating signposts towards which we will direct our attention moving forward as we attempt to understand the health of the single-family home in an equitable manner during the COVID-19 crisis. These signposts are developed to organize the salient topics for designers as they develop their own solutions to augment the well-being of families during this unprecedented time.

In building upon these five principles and creating the COVID-19 Home Signposts for Urban Families, which are based on existing best practices within the pandemic for buildings, our group feels that we have identified challenges related to equity and access that need to be the next area of examination within our urban environment. We recognize that the one-off, highly customizable nature of the single-family home may limit the generalizability of studying homes as they relate to health. However, the current COVID-19 crisis, raises questions about the nature of how residential spaces can mitigate or cause the spread of disease. The work presented in this article aims (non-critically) to highlight the inequities within our current building standards in light of the current crisis. The goal is to outline how recommendations might be modified in the future to consider the smaller scale housing situation for underserved populations. We consider these topics to be urgent in recognizing the role of housing in the journey to health and wellness, especially as the COVID-19 pandemic further exposes the imbalances in our urban communities.

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