Deloitte.

HEALTH EQUITY THROUGH ANALYTICS (HExA) SERIES

Volume 3: **Infrastructure as a driver of health**

Table of contents

EXECUTIVE SUMMARY

Executive summary

The data says it all

In this volume you'll find that local infrastructure can have important implications for health outcomes. However, with infrastructure often being outside the direct control of the individual, there should also be additional direct contextualization when solutioning.

Infrastructure and community health are connected

1. More nuance and contextualization should be involved when considering infrastructure as a driver of health.

2. While homeownership may be a major milestone and pathway to financial stability, it may also be very stressful when the debt-to-income ratio is high.

3. Dense housing and urban crowding may have disadvantages, but they may also provide better local access to services and support a social community that fosters social connectedness.

4. Working from home may provide health benefits to the community overall. Additionally, different income groups may benefit differently from these opportunities involving more community-specific approaches.

5. Access to broadband and the technology to use it seems to support improved community health; however, county income modifies this relationship unevenly. There may be other individual-level drivers of health also associated with income that may be modifying technology's relationship to better health outcomes.

AWARENESS AND EARLY PREVENTION CAN MATTER

Upstream equal opportunities and awareness have the greatest potential for improving disparate long-term health outcomes

ONE GROUP CANNOT SOLVE THIS ALONE

Stakeholder involvement across industries and within a community setting can be important to developing comprehensive, innovative, relevant solutions

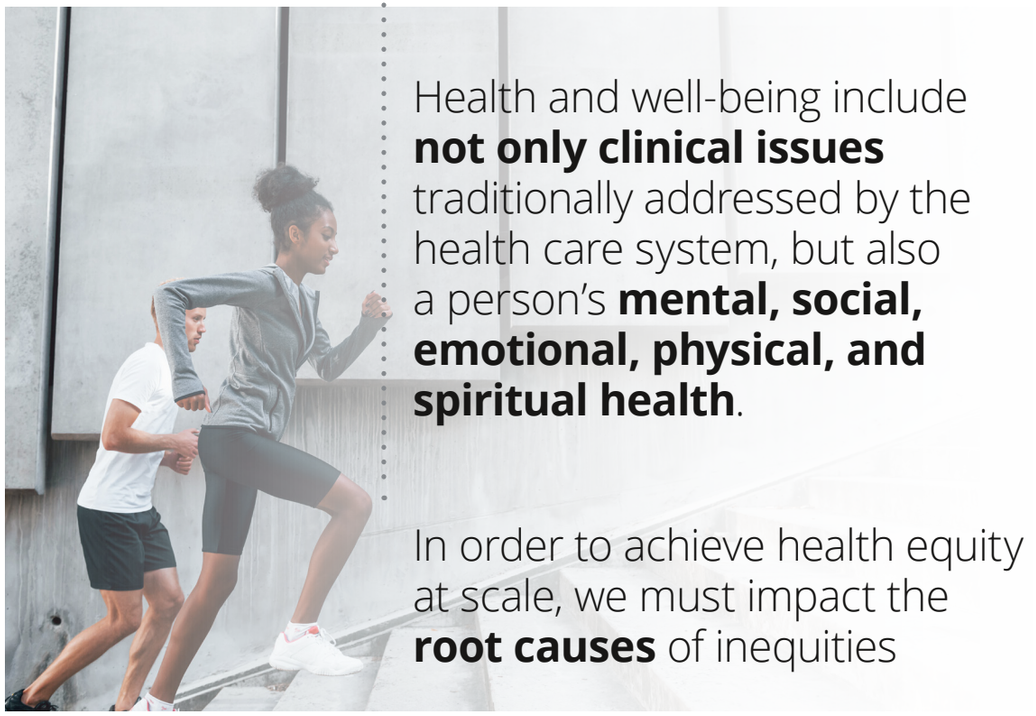
THE ISSUE IS COMPLEX, YET APPROACHABLE

While outcomes are influenced by many overlapping factors, we can detangle the complexity and look for smaller, approachable gaps to inform action that can compound over time into meaningful long-term impact

Executive summary

Health equity is more than equal access to care

It is the **fair and just opportunity** for everyone to fulfill their human potential in all aspects of **health and wellbeing**



Health and well-being include **not only clinical issues** traditionally addressed by the health care system, but also a person's **mental, social, emotional, physical, and spiritual health**.

In order to achieve health equity at scale, we must impact the **root causes** of inequities

DELOITTE HEALTH EQUITY INSTITUTE

The Deloitte Health Equity Institute (DHEI) launched in 2021 to...

1. Collaborate with **community organizations** to help move the needle in health equity
2. Further support Deloitte's **internal action** on health equity and offer **client service teams** with health equity expertise
3. Galvanize change in the ecosystem by **sharing data, research, and insights**

The DHEI recognizes data and analytics as essential to enabling its mission. **Our Health Equity through Analytics (HExA) series** aims to empower communities to improve health outcomes through targeted, data-driven interventions.

HExA SERIES OVERVIEW

Series overview

The Deloitte Health Equity Institute (DHEI) Health Equity through Analytics (HExA) series has three primary goals:

1. **Deepen our understanding of drivers of health** by putting real-world numbers behind associations
2. **Clarify and segment analyses** in a way that makes insights and recommendations actionable for community leaders
3. **Share knowledge broadly** with an invitation to complementary and diverse stakeholders across sectors and industries to develop and take action on solutions together

We hope these insights provoke conversation and catalyze collaborations that ultimately change future outcomes through **innovative solutions and mindsets**.

But this is only a starting point and one small step in the journey forward.

Series overview

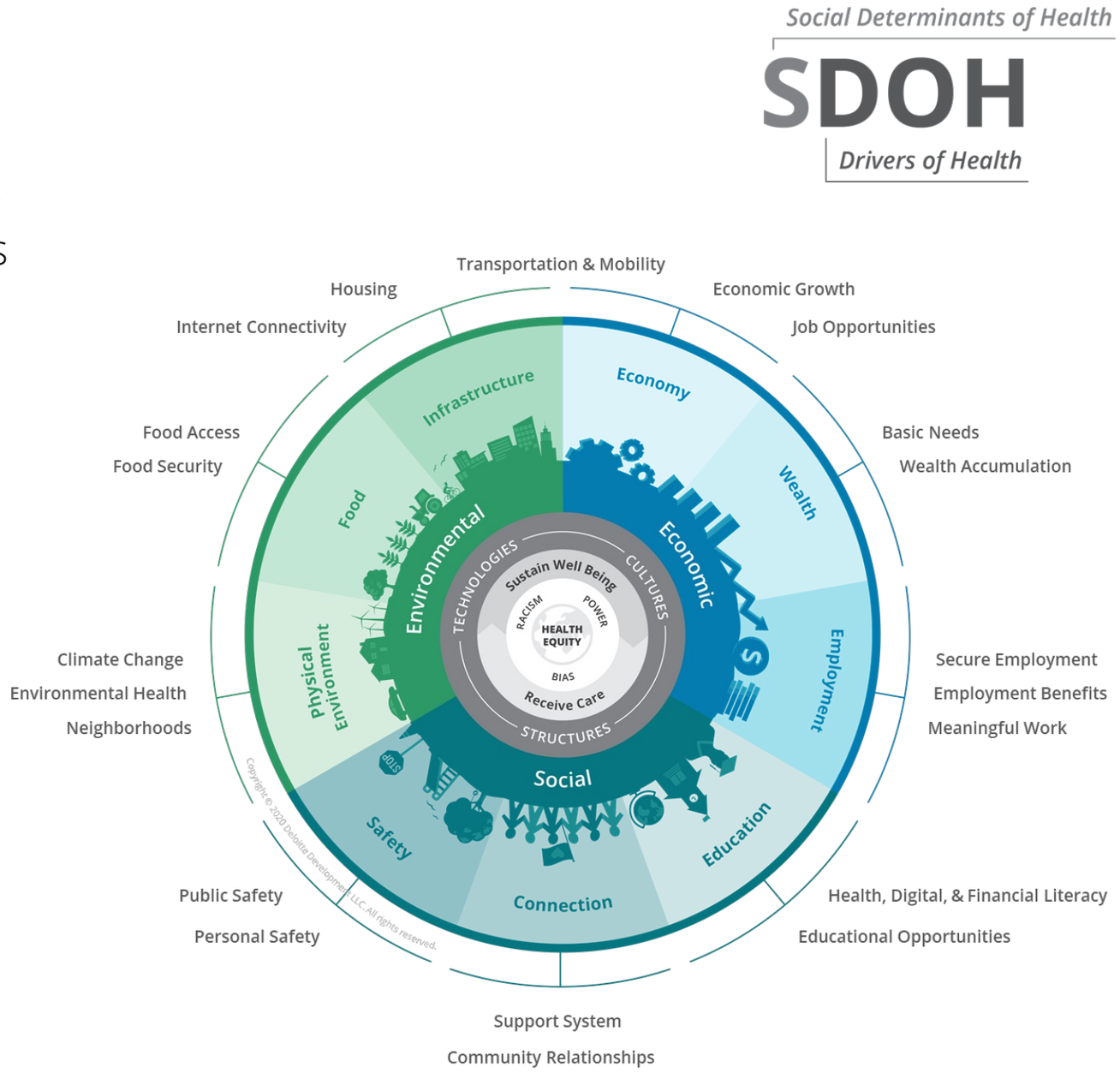
Deep inequities in **upstream** drivers of health are often the foundation of disparate health outcomes

The main feature of the HExA series is the sequential exploration of relationships between **drivers of health** and health outcomes through the combination of various and diverse data sets.

DEFINING DRIVERS OF HEALTH

The Drivers of Health, also known as the Social Determinants of Health, are the social, economic, and environmental factors beyond health care that can have an impact on individual and community health, well-being, and equity.

- **Economic:** Factors that affect the economy, such as steady employment, interest rates, policies, and governmental activities.
- **Environmental:** Impacts of exposure to pollutants, climate change, a lack of nutritious food sources, and unstable or unsafe living conditions.
- **Social:** Barriers to higher education and job training, lack of connection or relationships, and exposure to intentional violence.

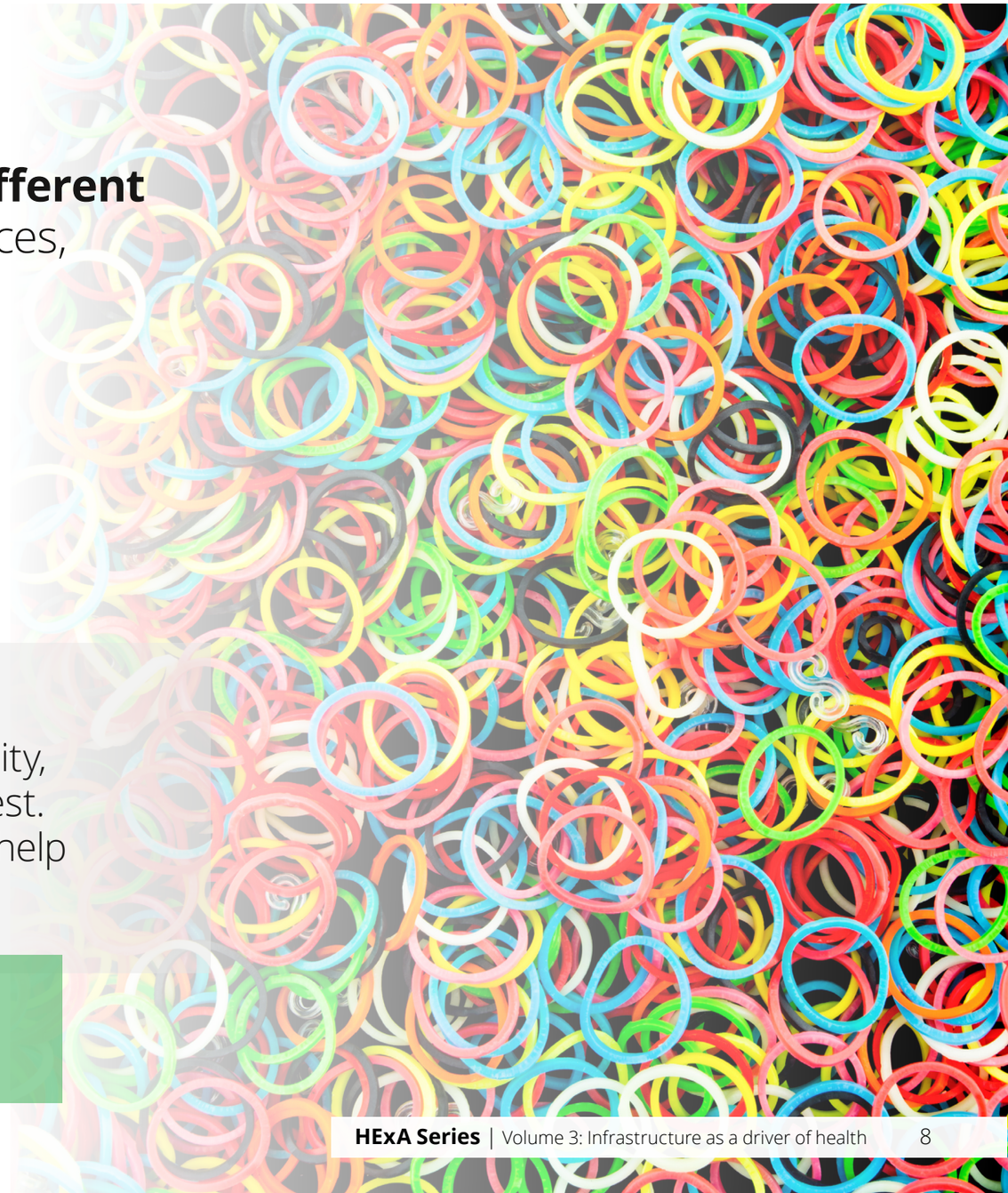


Series overview

There is **inherent complexity within and between the different drivers of health**. In combination with unique lived experiences, these drivers can impact individual health outcomes

Challenges to building a comprehensive perspective include:

- **Data intricacies**
- **Intersections across drivers of health**
- **Unique lived experiences**



UNTANGLING COMPLEXITY

While our population-level analysis cannot determine causality, we ***can*** identify initial trends and formulate hypotheses to test. Additional individual data and direct community insights can help complete a more comprehensive view.

A second phase of this series and research aims **to layer in targeted analyses** and **engage communities** to validate findings and strengthen the evidence base.

Series overview

We can work to **untangle the complexity** by identifying approachable gaps through critical questions:

CAN WE QUANTIFY THE FACTORS THAT CONTRIBUTE MOST TO HEALTH?

HOW CAN WE PRIORITIZE EFFORTS AND RESOURCES ACROSS COMMUNITIES AND POPULATIONS?

WHAT ACTIONS LEAD TO AND MAXIMIZE MEASURABLE IMPACT?

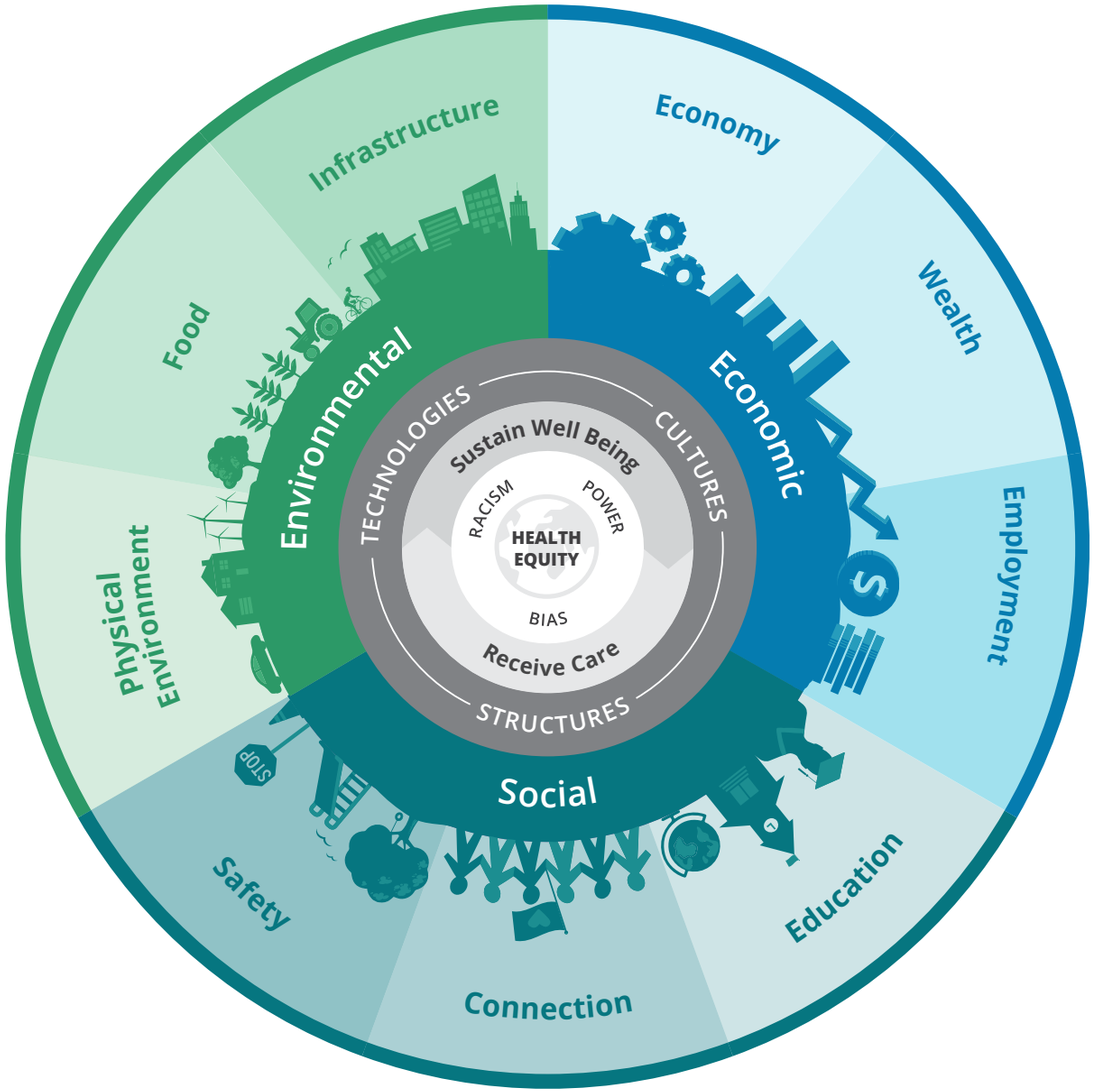
Social Determinants of Health
SDOH
Drivers of Health

Series overview

Data can help us identify these approachable gaps that lead to action and measure impact

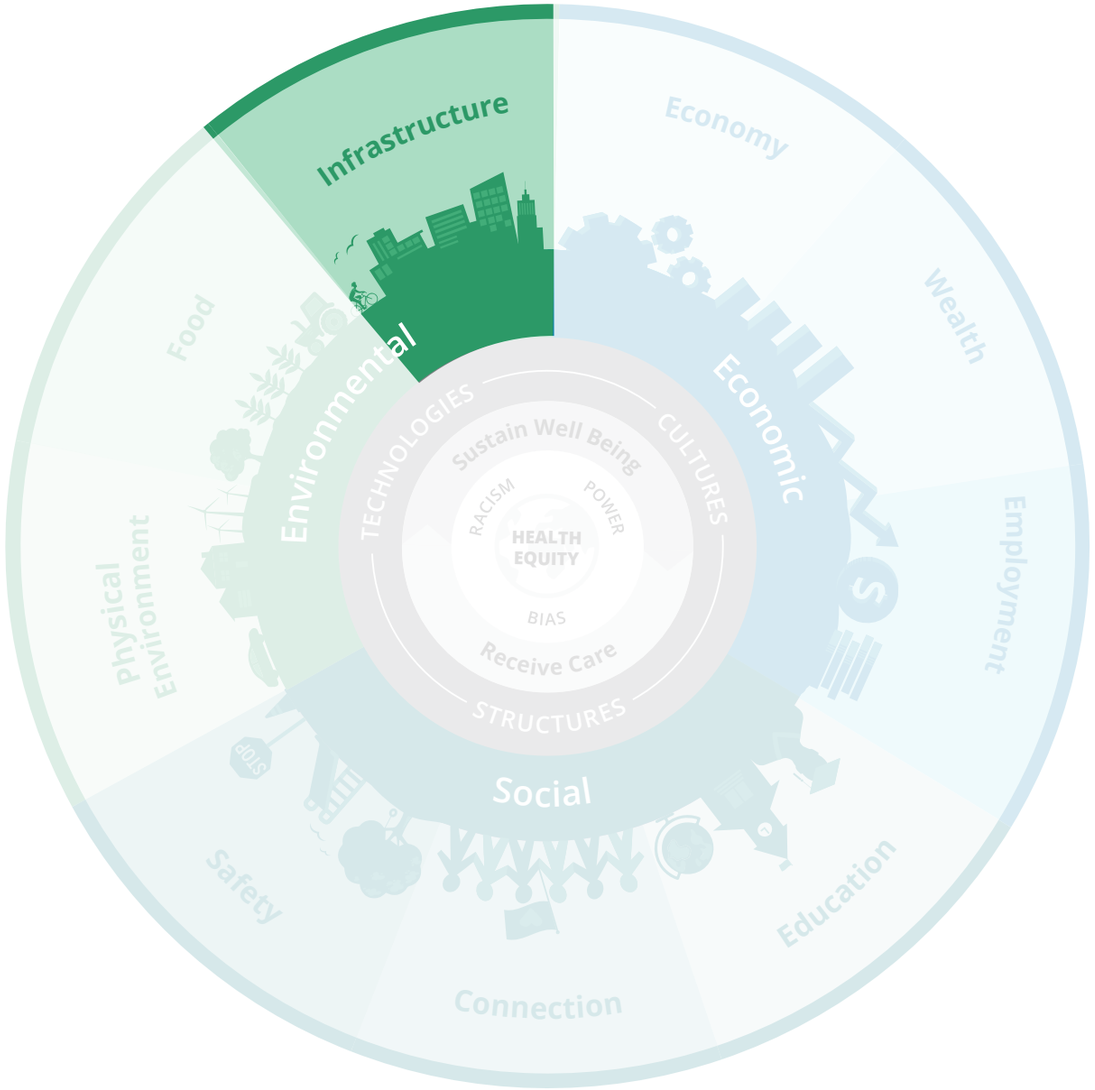
DATA CAN ENABLE US TO

- **Think differently** about where, when, and how we address health inequities.
- **Expose critical gaps and opportunities** to make an impact through a more comprehensive understanding of relationships between drivers of health.
- **Tell stories that reveal unexpected truths** about health inequities.
- **Measure the impact of novel interventions** to extract the most influential drivers.
- **Draw insightful conclusions** about previously unexplored populations and community needs through aggregation and segmentation.



Series overview

Our third volume in the series focuses on **infrastructure**—represented by housing, commute, and technology access



LET'S EXPLORE:

How are structural and environmental variables connected to personal health?

How can local infrastructure be incorporated in multifactorial and multilevel solutioning for improving community health?

How can key local and health care stakeholders in a community come together to improve health outcomes for the community?

Local infrastructure and the impact on prevalent chronic conditions and general wellness

This series includes the following topics:

Defining infrastructure

A **general overview** of infrastructure in the context of health

Findings from a **population-level data analysis** connecting county-level health outcomes to:

- Housing variables
- Commuting
- Technology variables

Bringing it all together

An assessment of implications for action

Understanding infrastructure

Infrastructure, or built environment, comprises the facilities, systems, and services that are the foundation to an operational environment in a locality.

In this series, we explore community health through three aspects of infrastructure that support the home, work, and means of virtual connectedness.[1]

(Also check out our second volume in the HExA series on social connectedness as a driver of health to learn more.)

Housing

Commuting

Communications

Guiding questions

What is the relationship between infrastructure and long-term health outcomes in a community?

How can community stakeholders and health care organizations partner to improve health outcomes?

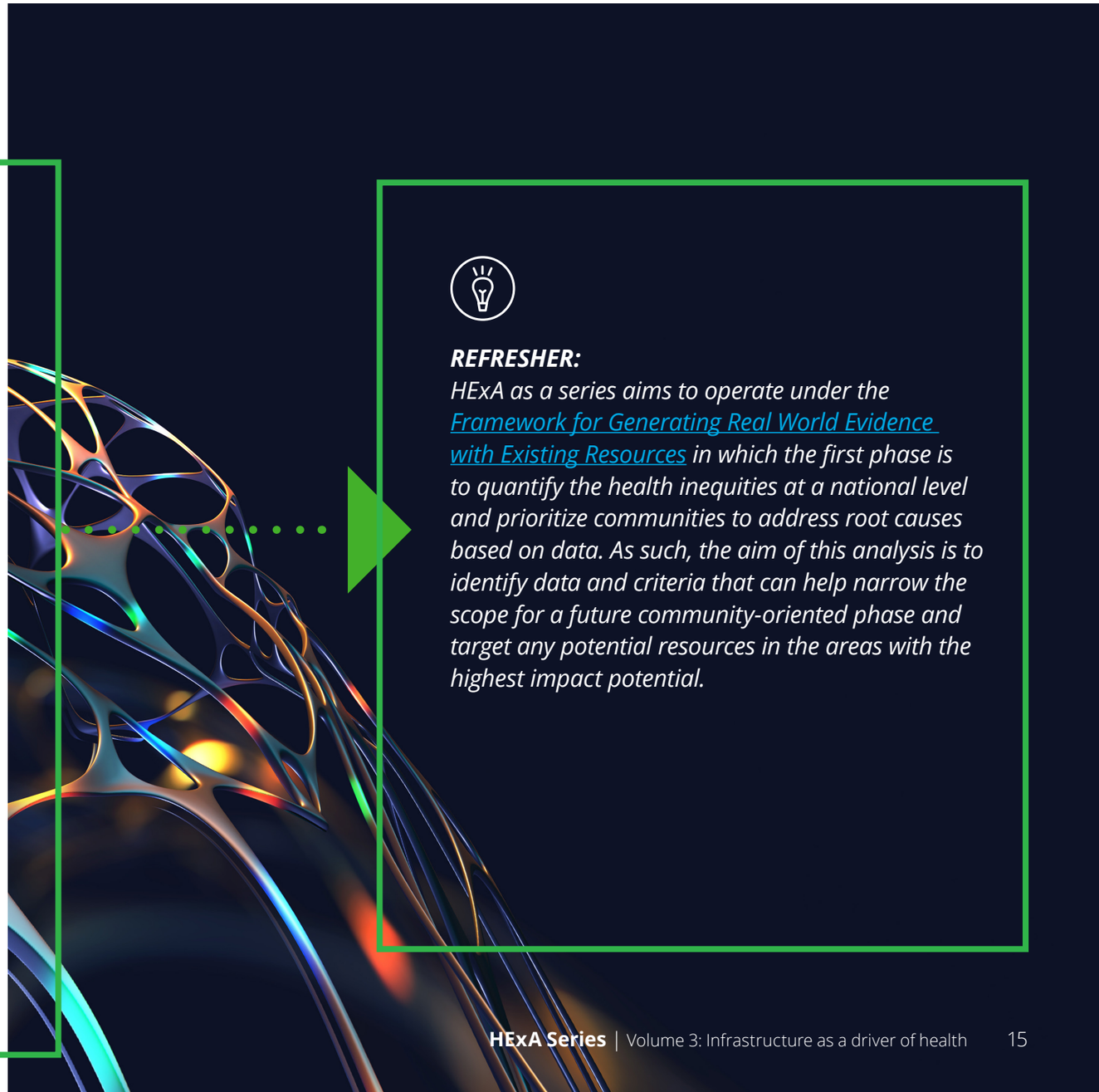
Is infrastructure a direct and independent contributor to health outcomes, or is it part of a more comprehensive view of drivers of health?

Good infrastructure is part of the foundation

Infrastructure intersects with health in multifaceted ways, potentially influencing everything from disease prevention to the management of chronic conditions.

- Quality housing infrastructure can protect against environmental hazards, while thoughtful urban design can promote physical activity and reduce lifestyle-related health issues.[2]
- Physical infrastructure can drive health outcomes by enhancing access to health care services through improved transportation networks, ensuring environmental quality via clean water, sanitation systems, and air pollution control.[3]
- Other infrastructure elements like broadband internet enable access to telehealth services and educational resources, and can enhance local food systems for improved nutrition, contributing to better health.[4]

(Also check out our first volume in the HExA series on education as a driver of health to learn more.)



REFRESHER:
HExA as a series aims to operate under the Framework for Generating Real World Evidence with Existing Resources in which the first phase is to quantify the health inequities at a national level and prioritize communities to address root causes based on data. As such, the aim of this analysis is to identify data and criteria that can help narrow the scope for a future community-oriented phase and target any potential resources in the areas with the highest impact potential.

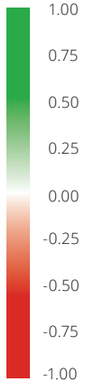
Unpacking the data

Housing

Prior literature shows that housing could have an impact on health across physical, mental, and social dimensions. Poor housing conditions can lead to respiratory issues and injuries, while housing instability heightens stress and mental health problems.[5] Additionally, high housing costs can force compromises on essentials like health care and nutrition, affecting long-term health.[6] Meanwhile, good neighborhood connections and access to local resources enhance social well-being and overall health.[7] Thus, **the quality, affordability, and location of housing are elements of overall health and well-being**.

Translating these ideas to population-level analysis, our initial county-level results showed **correlation between housing density and prevalence of chronic health conditions** both at a national level, and when stratified by county income groups. However, **the association of homeownership and county-level health outcomes became apparent only after stratifying by county income**. This stratification shows that **the relationship between housing and health outcomes appears to be, in part, modified by the average income of the county**.

Correlation heatmap



	All counties							
	County-level chronic disease prevalence						County-level overall wellness	
	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health
Housing ownership	0.19	0.38	0.00	0.30	0.20	0.16	-0.26	0.04
Housing density	-0.50	-0.50	-0.41	-0.56	-0.52	-0.49	-0.17	-0.48

	Lower-third of county income								Middle-third of county income								Upper-third of county income							
	County-level chronic disease prevalence						County-level overall wellness		County-level chronic disease prevalence						County-level overall wellness		County-level chronic disease prevalence						County-level overall wellness	
	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health
Housing ownership	0.16	0.49	-0.07	0.44	0.27	0.14	-0.31	0.06	0.44	0.53	0.25	0.62	0.43	0.52	-0.35	0.22	0.46	0.43	0.20	0.46	0.41	0.37	-0.13	0.23
Housing density	-0.33	-0.40	-0.23	-0.42	-0.33	-0.31	0.05	-0.31	-0.42	-0.47	-0.33	-0.53	-0.46	-0.45	0.15	-0.37	-0.53	-0.45	-0.39	-0.58	-0.58	-0.49	-0.12	-0.51

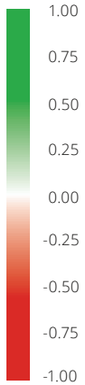
Housing ownership refers to the proportion of owner-occupied housing units
Housing density refers to the proportion of occupied housing units with 10 or more apartments

Unpacking the data

Housing (cont.)

Adding **housing cost burden as a variable *further* illuminated the relationship between housing and county-level health outcomes** likely due to its more direct impact on the individual.

Correlation heatmap



Counties where more than 1/4 of residents are spending 30% or more of their income on housing

	Lower-third of county income								Middle-third of county income								Upper-third of county income							
	County-level chronic disease prevalence						County-level overall wellness		County-level chronic disease prevalence						County-level overall wellness		County-level chronic disease prevalence						County-level overall wellness	
	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	CHD	COPD	CKD	Poor mental health	Poor physical health
Housing ownership	0.2	0.57	0.12	0.53	0.31	0.36	-0.46	0.20	0.44	0.57	0.32	0.76	0.65	0.64	-0.51	0.48	0.43	0.42	0.13	0.53	0.48	0.40	-0.22	0.27
Housing density	-0.44	-0.54	-0.38	-0.55	-0.48	-0.48	0.09	-0.46	-0.34	-0.42	-0.32	-0.61	-0.59	-0.52	0.27	-0.58	-0.42	-0.33	-0.25	-0.58	-0.58	-0.46	-0.09	-0.50

HIGHLIGHTS

1. **Income and affordability may moderate the relationship between housing and community health**.
   - County-level housing appears to be an indirect social driver. There are many structural aspects outside the control of the individual, which should be considered alongside additional individual-level factors when solutioning.
2. When stratifying for county income and accounting for the cost burden of housing, there appears to be a positive association between homeownership and chronic conditions (i.e., **as the proportion of owner-occupied housing units increases, there also appears to be an increase in community-level prevalence of chronic conditions**).
   - This may be due to the **stress of homeownership**, particularly as the cost burden becomes more than 30% of a household's income.
3. When stratifying for county income and accounting for the cost burden of housing, there appears to be a negative association between denser housing and chronic conditions (i.e., **as the proportion of denser housing increases, the prevalence of community-level chronic conditions decreases)**.
   - This may be due to **several factors**, which could include the **difference between urban and rural housing**, the creation of a **community and social connectedness in more densely populated counties**, and the **availability of more proximate health resources in densely populated areas**.

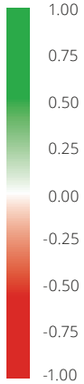
Unpacking the data

Commuting

The intricate relationship between transportation, commuting, and health is a multifaceted issue that extends beyond mere convenience and efficiency. As urbanization accelerates and metropolitan areas expand, the daily commute has become a major part of many individuals' lives, often consuming significant portions of their day. This routine activity can have profound implications for public health, influencing physical, mental, and social well-being.[8] However, a significant working culture shift around the COVID-19 pandemic opened the opportunity for working from home to a greater proportion of the population than ever before.[9]

Translating these ideas to population-level analysis, and accounting for average county-level income, **we found that an increase in the percentage of workers working from home (WFH) was associated with a decrease in the chronic conditions and better lifestyle practices**. However, the correlations were much stronger among the high-income group.

Correlation heatmap



	Lower-third of county income								Middle-third of county income								Upper-third of county income							
	County-level chronic disease prevalence					County-level overall wellness			County-level chronic disease prevalence					County-level overall wellness			County-level chronic disease prevalence					County-level overall wellness		
	High BP	CHD	COPD	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health	High BP	CHD	COPD	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health	High BP	CHD	COPD	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health
Proportion of county WFH*	-0.28	0.07	-0.09	-0.21	-0.33	-0.35	-0.32	-0.18	-0.11	0.10	-0.20	-0.20	-0.41	-0.44	-0.42	-0.28	-0.39	-0.42	-0.49	-0.39	-0.60	-0.62	-0.30	-0.48

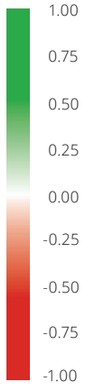
*The work-from-home and health outcomes data cross over the COVID-19 pandemic period. This analysis would benefit from an update when the data sources are refreshed to include meaningful time frames during and after the pandemic.

Unpacking the data

Commuting (cont.)

Working from home may offer a wellness benefit but may not be an equitable option across income groups.

Correlation heatmap



All counties

	County-level chronic disease prevalence					County-level overall wellness		
	High BP	CHD	COPD	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health
WFH	-0.43	-0.32	-0.43	-0.43	-0.56	-0.58	-0.47	-0.47

Income-stratified county-level overall wellness

County-level overall wellness

	Lower third of county income			Middle third of county income			Upper third of county income		
	Lack of physical activity	Poor mental health	Poor physical health	Lack of physical activity	Poor mental health	Poor physical health	Lack of physical activity	Poor mental health	Poor physical health
WFH	-0.35	-0.32	-0.18	-0.44	-0.42	-0.28	-0.62	-0.30	-0.48

Income-stratified county-level chronic disease prevalence

County-level overall wellness

	Lower third of county income					Middle third of county income					Upper third of county income				
	High BP	CHD	COPD	Diabetes	Obesity	High BP	CHD	COPD	Diabetes	Obesity	High BP	CHD	COPD	Diabetes	Obesity
WFH	-0.28	0.07	-0.09	-0.21	-0.33	-0.11	0.10	-0.20	-0.20	-0.41	-0.39	-0.42	-0.49	-0.39	-0.60

HIGHLIGHTS

1. There appears to be a community-level **increase in self-reported physical activity, physical health, and mental health as the proportion of the population that works from home increases**. However, the **wellness benefits are not evenly distributed** when stratifying for county income.
   - When stratified for county income, the association with working from home and **increased physical health and activity was mainly seen in the higher-income counties**. Meanwhile the **benefits of better mental health were seen in middle-income counties**.
2. **Income appears to modify the relationship** between the ability to work from home and the lifestyle and wellness benefits it may support.
   - This modification can be due to several reasons, which include the availability, (or lack thereof), of work-from-home opportunities in the various income ranges.
   - Working from home may confer different benefits to different groups due to their other daily needs.

Unpacking the data

Technology

Broadband connectivity—and the technology to utilize it—may be a key infrastructure that can support the health of communities. As other established drivers, such as education, employment opportunities, and job training, are increasingly premised on the availability of connectivity, broadband may be a gateway to the other determinants.[10]

Our analysis reveals that county-level **broadband access and availability of desktop/ laptop devices in the household positively relate to improved chronic disease conditions and lifestyle factors** in the community. However, when stratifying for county income, the overall correlation is modified to be lower.

Correlation heatmap

	County-level chronic disease prevalence				County-level overall wellness		
	High BP	High choles-terol	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health
Broadband access	-0.65	-0.45	-0.71	-0.52	-0.67	-0.40	-0.66
Desktop or laptop access	-0.72	-0.49	-0.80	-0.66	-0.83	-0.55	-0.78

	Lower-third of county income							Middle-third of county income							Upper-third of county income						
	County-level chronic disease prevalence				County-level overall wellness			County-level chronic disease prevalence				County-level overall wellness			County-level chronic disease prevalence				County-level overall wellness		
	High BP	High choles-terol	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health	High BP	High choles-terol	Diabetes	Obesity	Lack of physical activity	Poor mental health	Poor physical health
Broadband access	-0.39	-0.12	-0.53	-0.32	-0.42	-0.16	-0.39	-0.37	-0.35	-0.36	-0.21	-0.31	0.05	-0.30	-0.41	-0.31	-0.43	-0.40	-0.51	-0.08	-0.42
Desktop or laptop access	-0.49	-0.13	-0.66	-0.53	-0.68	-0.35	-0.54	-0.45	-0.36	-0.53	-0.46	-0.65	-0.24	-0.51	-0.49	-0.34	-0.59	-0.55	-0.73	-0.27	-0.60

HIGHLIGHTS

1. There appears to be an overall community-level **decrease in chronic conditions and self-reported poor physical health** with increased broadband access and the technology to utilize it. However, the **benefits are not evenly distributed** when stratifying for county income.
   - When stratified for county income, the associations between broadband access and **increased physical health and decreased chronic condition prevalence was reduced in all of the income groups, though higher-income counties showed a relatively higher correlation**.
   - In the income stratified analysis, **the positive association between household availability of a desktop/laptop and better health outcomes held up more strongly** than the correlations with broadband **but was still reduced.**
2. **Income appears to modify the relationship** between the access to technology and communications and the lifestyle and wellness benefits it may support.

What could impact look like?

We may see the **greatest opportunity for impact on health outcomes** by considering structural and **indirect drivers** of health (e.g., infrastructure) **in combination with more direct** and individual drivers of health (e.g., social connectedness), rather than as stand-alone contributors.

Bringing it all together

How can we move forward from here?

1. More nuance should be involved when considering infrastructure as a driver of health. Local infrastructure may be out of the control of the individual, thus variables such as income, access, and affordability should be considered when contextualizing the relationship between infrastructure and health outcomes.

2. While homeownership may be a major milestone and pathway to financial stability, it may also be very stressful when the debt-to-income ratio is high, thus leading to poorer health outcomes.

3. Dense housing and urban crowding may have disadvantages, but they may also provide better local access to services and support a social community that fosters social connectedness.

4. Working from home, instead of spending significant portions of the day commuting, may provide health benefits to the community overall. However, access and availability of these opportunities may not be evenly distributed across income groups. Additionally, different income groups may benefit differently from these opportunities (e.g., middle-income counties experience mental health benefits while higher-income counties experience better physical health).

5. Access to broadband and the technology to use it seems to support improved community health; however, county income appears to modify this relationship unevenly. There may be other individual-level factors also associated with income that may be modifying technology's relationship to better health outcomes (e.g., literacy).

Implications for action

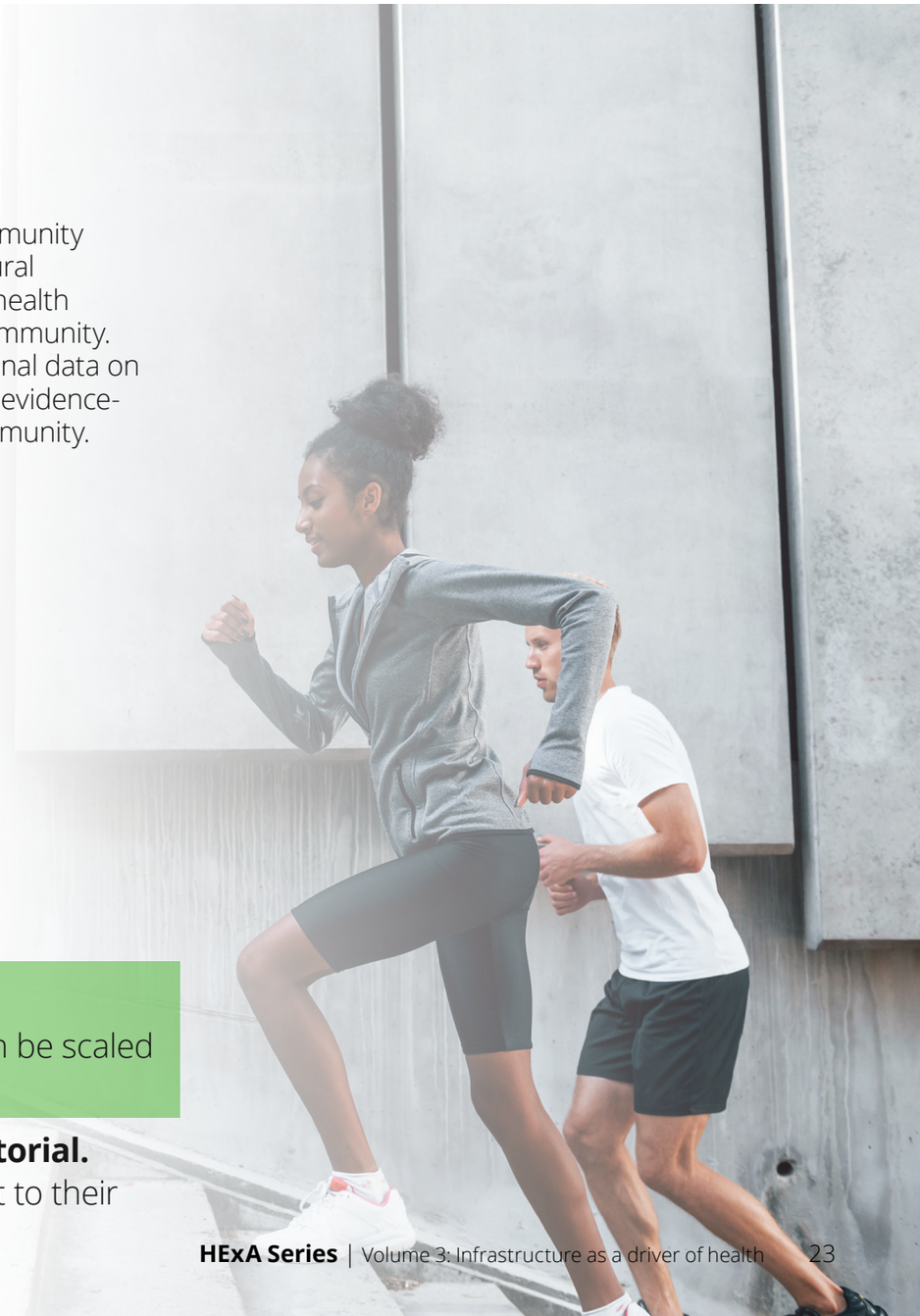
1 What is the role of community leaders, stakeholders, and policy?

Infrastructure is often outside the control of the individual and more a product of local government and policy. This can position key community stakeholders to consider the various nuances and interplay between larger infrastructural drivers of health and related individual drivers of health when creating new policies, structures, and systems. More nuance should be involved, which can be achieved through understanding the unique needs of each community and tailoring solutions to combine both indirect and direct drivers of health.

Additionally, there should be continued consideration beyond simply the access to the systems. For example, medical technology providers and community stakeholders can work together to understand how the community may best benefit from the availability of the technology through other more individual and community-specific programs. These may include education and training components that allow the systems to be used to their greatest potential.

2 How can health care providers lean in?

Providers may be able to work with local community leaders to better understand how the structural environment affects the individual drivers of health and ultimately health outcomes within the community. Providers may also consider collecting additional data on the drivers of health to support targeted and evidence-based infrastructural changes within the community.



The measurement imperative

It is essential to measure the ***effect*** of interventions and share which interventions work well and can be scaled and implemented in other communities.

We approached this work with the recognition that disparate outcomes are **complex and multifactorial. Individual communities** are best positioned to develop and tailor programs and solutions relevant to their context. **These suggestions are meant to inspire collaboration.**

How to take action with nuance: An example pathway

Hypothetical scenario:

*A local **health care provider** in a **lower-income county**—in coordination with **local government** stakeholders and a **MedTech provider**—would like to increase the use of telehealth services for greater outreach to the community and better preventive care.*

HOME

The health care provider may better understand the community needs by assessing what the housing conditions are. For example, if the community is more urban and has denser housing, the **health care provider may consider incorporating the individual's family and community connections in treatment planning**. Alternatively, if the environment is more rural, **more measures that assist in triaging virtually can be added**.

WORK

Work-from-home may not be as correlated to health in lower-income counties. However, the provider may work with local government to set up **other means of access to health-promoting activities** like local recreational centers or **better access to health care during flex hours** such as evening or weekend virtual clinics.

TECH

Access to broadband and the availability of technology to use it may be correlated to better health, though the relationship is attenuated by community income. Thus, providers and local government may look to supplement access to telehealth with other supportive mechanisms in coordination with the MedTech provider. For example, this could be in the form of **locally held training, information, and education sessions on how to best utilize technology.**

Conclusion

Infrastructure is a foundational piece to community health

Key learnings

1. More nuance and contextualization should be involved when considering infrastructure as a driver of health.

2. While homeownership may be a major milestone and pathway to financial stability, it may also be very stressful when the debt-to-income ratio is high.

3. Dense housing and urban crowding may have disadvantages, but they may also provide better local access to services and support a social community that fosters social connectedness.

4. Working from home may provide health benefits to the community overall. Additionally, different income groups may benefit differently from these opportunities involving more community-specific approaches.

5. Access to broadband and the technology to use it seems to support improved community health; however, county income modifies this relationship unevenly. There may be other individual-level drivers of health also associated with income that may be modifying technology's relationship to better health outcomes.

Moving forward together

The main goals of our HExA series are to deepen our knowledge on drivers of health, detangle and segment analyses, and share knowledge broadly in order to **inspire conversation and catalyze collaborations that ultimately address root causes.**

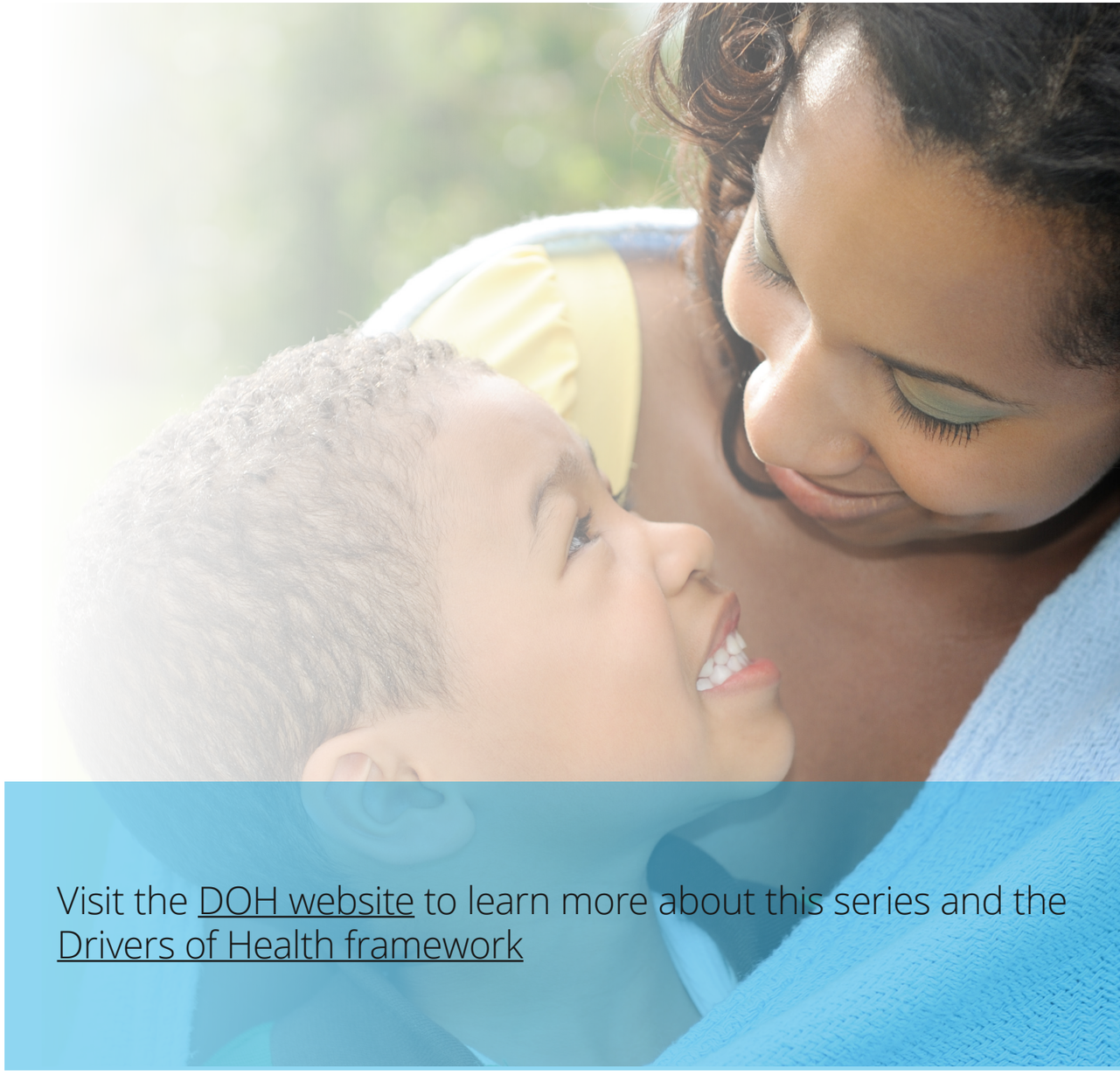
We also recognize that real-world **health care issues tend to be highly nuanced, complex, and multifactorial**. Thus, we need additional real-world research to keep building the evidence base, and this series is just the first step.

Furthermore, **each community is generally best positioned to develop and tailor programs and solutions relevant to their context.** Going as far upstream as possible should catalyze the greatest impact. However, an important mindset is starting somewhere, grounded in data, community engagement, and a commitment to identifying and taking action on approachable gaps within the complexity.

With some advanced planning, **evidence can be generated using existing sources**—any individual and organization can begin collecting information and measuring outcomes with openly available tools, resources, and collaborations.

Finally, the **criticality of measurement and evaluation cannot be overemphasized.** A better future relies on shared knowledge.

We look forward to engaging, sharing data and insights, and building solutions *together*.



Visit the DOH website to learn more about this series and the Drivers of Health framework

Conclusion

Empowered with this knowledge, we have both a responsibility and an opportunity.

Continue the conversation with us.

Authors and outreach

HExA is developed and produced by the Deloitte Health Equity Institute (DHEI) Data and Analytics (D&A) team, **Pavan Kumar Bhoslay, Nivedha Subburaman, MDS,** and **Raviteja Saragadam,** led by D&A Manager **Elya Papoyan, MPH,** with the leadership support of DHEI Senior Manager **Nicole Kelm, DPT, MPH,** and Managing Director **Jay Bhatt, DO, MPH, MPA.**

DHEI Health Equity Research Manager **Maningbè Keita Fakeye,** PhD, provides subject-matter knowledge on methodology and interpretation.

The project also includes analytics contributions from **Tyler Cote, ASA, MAAA** (Deloitte Consulting LLP).

Elya Papoyan
Manager, Data & Analytics
Deloitte Health Equity Institute
Deloitte Services LP
epapoyan@deloitte.com

Nicole Kelm
Senior Manager
Deloitte Health Equity Institute
Deloitte Services LP

Jay Bhatt
Managing Director
Deloitte Center for Health Solutions &
Deloitte Health Equity Institute
Deloitte Services LP

Data and methodology

Infrastructure

Infrastructure data including housing and housing burden, housing cost burden, commute, and broadband was sourced from the US Census Bureau 5-year estimates. The household desktop or laptop prevalence was sourced from Agency for Healthcare Research and Quality (AHRQ) SDOH files.

Population-level health outcomes

Data on chronic conditions as well as the assessment for overall physical and mental health was sourced from PLACES, a collaboration between the Centers for Disease Control and Prevention (CDC), the Robert Wood Johnson Foundation, and the CDC Foundation. PLACES provides health data for small areas across the country. Data sources used to generate these model-based estimates include Behavioral Risk Factor Surveillance System (BRFSS) data, Census Bureau county population estimate data, and American Community Survey (ACS).

All conditions are presented as the proportion of the population aged 18 and older that self-report having the condition in the county. For physical and mental health status, the variable is defined as "mental/physical health not good for 14 days or more among adults aged 18 years and older."

Income

Household median income is sourced from the County Health Rankings, which, in turn, sources the data from the 2020 Small Area Income and Poverty Estimates. After sorting all US counties by this variable, we divided the counties into thirds. Upper third of national income is defined here as the top third of US counties with respect to income. Lower third of national income are the bottom third of US counties with respect to income. The middle third of national income is the middle third. Upper third of national income is defined as the top third of US counties with respect to median income.

Methodology

The association between infrastructure and health was calculated in each of the combination of variables using the Pearson correlation.

The US Deloitte Health Equity Institute

LEARN MORE ABOUT THE DELOITTE HEALTH EQUITY INSTITUTE

The mission of the Deloitte Health Equity Institute (DHEI) is advancing health equity to make an impact that matters. To do it, we're creating cross-sector collaborations and tools aimed at addressing disparities in the drivers of health, racism and bias, and structural flaws in the health system. Our goal is to create exponential change that will lead to a world in which health isn't determined by race, gender, ability status, or zip code. One in which all people have the fair and just opportunity to achieve their full potential in every aspect of their health and well-being.

National, regional, and local data on health equity
Explore our publicly available tools developed to make insights available and actionable for communities at large. Tools include Deloitte's Health Equity Dashboard, Surgo US COVID-19 data explorer, and the March of Dimes Maternity Care Deserts Dashboard.

Actionable insights and playbooks
Discover thought leadership and topical conversations with actionable recommendations for organizations and individuals to take action toward improving health equity.

Join the conversation
Looking to talk more about health equity or advance your own efforts to advance issues of equitable care? We'd love to learn how we can help you work toward better health outcomes. Let's talk and make a meaningful difference.

Endnotes

1. Ray Oldenburg, *The Great Good Place* (Cambridge, MA: Da Capo Press, 1999); Jessica Finlay et al., "Closure of 'third places'? Exploring potential consequences for collective health and wellbeing," *Health Place* 60 (November 2019): 102225.
2. Janet Ige et al., "The relationship between buildings and health: A systematic review," *Journal of Public Health (Oxford, England)* 41, no. 2 (June 2019): e121–e132; US Environmental Protection Agency (EPA), "Connection between environmental exposure and health outcomes," last updated July 8, 2024.
3. Robyn Correll, "What is environmental health and what critical issues impact our health?," *Verywell Health*, February 23, 2024.
4. National Library of Medicine, *2022 National Healthcare Quality and Disparities Report* (Rockville, MD: Agency for Healthcare Research and Quality, 2022); Natalie C. Benda et al., "Broadband internet access is a social determinant of health!," *American Journal of Public Health* 110, no. 8 (August 2020): pp. 1123–25.
5. Alessia Riva et al., "Can homes affect well-being? A scoping review among housing conditions, indoor environmental quality, and mental health outcomes," *International Journal of Environmental Research and Public Health* 19, no. 23 (December 2022): 15975.
6. Amy Clair and Amanda Hughes, "How renting could affect your health," World Economic Forum, February 11, 2019.
7. Meridith Sones, "How social connectedness between neighbours supports health and well-being," Hey Neighbour Collective of the Simon Fraser University Morris J. Wosk Centre for Dialogue, June 3, 2022.
8. Kiron Chatterjee et al., *The commuting and wellbeing study: Understanding the impact of commuting on people's lives*, University of the West of England – Bristol, October 23, 2017; Jaana I. Halonen et al., "Commuting time to work and behaviour-related health: A fixed-effect analysis," *Occupational and Environmental Medicine* 77, no. 2 (February 2020): pp. 77–83.
9. Kathryn Vasel, "Two years later, remote work has changed millions of careers," CNN Business, updated March 18, 2022.
10. Federal Communications Commission (FCC), "Studies and data analytics on broadband and health," last updated January 26, 2024.

Deloitte.

9760309