



New understandings of health and well-being highlight the importance of imagining health interventions that do not simply act on our individual bodies, but operate at multiple scales.

This set of Health Horizons forecast perspectives offers a view of six key areas of experimentation that operate across the scales of bodies, networks, and environments. These experiments emerge as responses to six key questions shaping health and well-being.



why **time** matters

Kathi Vian

New research into our bodies' internal clocks is revealing that personal timing mechanisms shape the effects of health and medical interventions—and raising questions about how to time interventions to enhance health.

why **spirituality** matters

Rachel Hatch

Enhanced measurement capabilities such as fMRI are creating space for evidence-based spirituality—and creating new opportunities, and raising age-old tensions, about ways to quantify and measure spiritual interventions to enhance health.



why **trust** matters

Bradley Kreit

High-trust networks that promote sharing, trust, and localized social safety nets are key measures of health—and leading to efforts to understand and manage the process by which communities create trust and social cohesion.

why **identity** matters

Brinda Dalal

Diverse data sources, ranging from social networking profiles to electronic medical records, won't just offer increasingly personalized accounts of health—but will also force many people to reexamine personal and family health and identity.



why **measurement** matters

Rachel Maguire

Tracking and measuring how physical environments influence health and behavior is creating new understandings of how cities influence well-being—and raising questions about how to address environmental health disparities.

why **place** matters

Ben Hamamoto

As the effects of local place on health become clear, bottom-up efforts to enhance local environments to improve health will look to optimize physical as well as social narratives of place—and challenge us to rethink ways to enhance community health.

Each of these six perspectives forecast new health and well-being innovations. In addition, each one also offers alternative-futures scenarios, designed to stretch your thinking, exploring how these strategies could evolve in radically different ways over the coming decade. Each piece concludes with a set of implications and key tensions emerging from the forecast and scenarios to jump-start your thinking about possible responses and potential pitfalls stemming from moving this forecast toward action.

These pieces were developed as part of Health Horizons' research on Ecosystems of Well-Being. You can use them to begin developing health and well-being responses and initiatives that will be resilient in a decade of incredible possibility and uncertainty.

about the ...

HEALTH HORIZONS PROGRAM

IFTF's Health Horizons Program offers its clients a deep understanding of the global health economy and the social forces that will shape health and health care in the next three to ten years. We identify and evaluate emerging trends, discontinuities, and innovations in consumer behavior and social media; health and medical technologies; health care delivery systems; and food, nutrition, and sustainability. Our forecasting process helps organizations work with foresights to develop insights that lead to specific strategic actions they can use to better position themselves in the marketplace.



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why spirituality matters

While people have viewed their own well-being through a spiritual lens for millennia, emerging fields such as cognitive neuroscience and evolutionary psychology are bringing rigor to these subjective feelings and pinpointing physical health costs and benefits of practices as diverse as attending religious services and spending time in nature. These findings are laying the groundwork for a future of evidence-based spirituality. Researchers are not only identifying connections between spirituality and well-being but also showing that a rich inner life can translate to enhanced physical health. Over the next decade, as these relationships become clearer, we will begin to quantify the health and well-being effects of spiritual practices—for better or worse—and piece them together to take care of ourselves in a volatile world.

Focused at the **scale of bodies**, this forecast perspective explores emerging responses to the question of **why spirituality matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that spirituality could reshape health and well-being.

Practices unmoored

Expanding the menu of well-being options

Spiritual practices such as yoga are already being prescribed to treat health concerns, including stress, hypertension, and back pain. In the next decade, these kinds of spiritual practices will become increasingly unmoored from their traditional cultural context, in part due to globalization, and will be seen as something people can pick and choose in order to fill their emotional and physical health needs. This decontextualization of religious practice is not simply creating resources for self-experimentation and self-improvement; it is also laying the groundwork for medical and scientific communities to begin testing, evaluating, and prescribing different kinds of spiritual practices to enhance mental and physical well-being.

Spirituality quantified

Making the invisible visible

Research in neuroscience and other fields is quantifying how spiritual practices impact physical health. For instance, studies of people who meditate show changes in everything from gene expression to gray brain matter related to memory. Similar studies have found that attending religious services is correlated with boosted immunity and that spending time in nature can decrease anger and stress. On the other hand, a recent Northwestern University study linked church attendance with obesity. Awareness of the proven benefits of specific spiritual practices will cause us to rethink our daily routines to make time for nurturing the inner life.

Stress defused

Cultivating inner resilience

One immediate target for spiritual health interventions will be stress. An increasingly common problem associated with economic turbulence, poverty, and other external challenges, stress has been linked to long-term health conditions, including heart disease, insomnia, and digestive problems. One key tension point here will involve the place of technology and techno-spiritual practices. While technologically augmented spiritual tools such as Mecca-finding phone apps and Catholic confession apps will proliferate, nudges to turn off technology for the sake of the inner life will also abound. Identifying personalized spiritual strategies to cope with the stresses of daily life will be a route to improved well-being.

—Rachel Hatch



expert voices **MARY JO KREITZER**

RACHEL: Tell us a bit about what you are finding in terms of mindfulness meditation [which focuses on awareness] as an intervention for organ transplant patients. What significance does this practice of cultivating the inner life have for them?

MARY JO: My colleagues and I have conducted research on people who have received organ transplants such as liver, kidney, and heart transplants. For many of these people, the transplant was life saving and their transplanted organs function very well. However, even with a healthy kidney or liver, many of these people experience ongoing anxiety, depression, and difficulty sleeping. This significantly impacts their quality of life. In a study funded by the NIH, we studied the impact of mindfulness meditation. It was a rigorously designed randomized, controlled clinical trial. Our results were interesting. Mindfulness meditation not only reduced people's anxiety and improved their depression, it significantly impacted their sleep. We were particularly pleased to discover that the benefits of meditation were sustained beyond one year, the length of time we followed them in the study. Our conclusion was that mindfulness meditation is a relatively inexpensive, safe, and effective community intervention.

RACHEL: In your research on people with insomnia, how do the mindfulness therapies stack up against the psychopharmatherapies?

MARY JO: Based on the findings in the study I just described, we were curious to see if mindfulness meditation would be effective in treating people with chronic primary insomnia. Insomnia is a big deal in this country. One in ten people report having insomnia, and it has a significant impact on overall health, happiness, and productivity. The costs of treating insomnia are significant and growing. In this study,

my colleagues and I compared mindfulness meditation with a commonly used prescription drug. We thought that this was a rather good comparison as many people with insomnia turn to drugs for help, there are drugs that have FDA approval, and at some level drugs do work. In this study, we found that meditation was as effective as the drug. Treatment satisfaction was higher in the mindfulness meditation group. Meditation also offered the benefit of no side effects, and it is less expensive.

RACHEL: How would you define optimal healing environments?

MARY JO: The simplest definition would be environments that heal or promote healing—that make us whole. In the context of health care, we define optimal health environments as places or spaces that integrate evidence-based practice and evidence-based design in a way that optimizes health outcomes for patients, family, and staff. Within that context, it includes patient-centered, relationship-based care; attentiveness to the whole person (body, mind, and spirit); and the use of all appropriate interventions (biomedical and integrative). The space or physical environment is also important. We know that access to nature, natural light, noise control, positive distraction, and access to social support (presence of family and friends) is also very important. I teach a graduate-level course on this topic and the students are always eager to learn about the care processes and space attributes that contribute to better health outcomes. I am eager to point out, however, that the most important factor in creating optimal healing environments is the care providers themselves offer—the gifts, talents, competencies they bring to the healing encounter.

Mary Jo Kreitzer is founder and director of the Center for Spirituality and Healing at the University of Minnesota.

A registered nurse, she is an expert on integrative health and medicine. Together with her colleagues and students, she researches optimal healing environments, complementary medicines and healing practices, and mindfulness-based stress reduction.

RACHEL: Within optimal healing environments, what role does spirituality or the inner life play?

MARY JO: The idea of attending to spiritual care is not new. Spirituality, broadly defined, is that which gives meaning and purpose to life. The word *spirit* comes from the Hebrew word *ruah*, which literally means wind, breath, or air, that which gives life. When you think of spirituality in those terms, it becomes apparent that it is vital that we attend to people's spiritual needs just as we do their physical needs. When people are diagnosed with a chronic or life-threatening illness, it is not unusual for them to have feelings of anger, grief, loss, despair, or hopelessness; these feelings may in turn provoke spiritual distress. Health care teams need to be prepared to provide spiritual care. While much of what we do in health care requires technical skills, providing spiritual care requires skills of deep listening, compassion, mindfulness, and presence.

RACHEL: Over the next ten years, do you see us having the knowledge we need in order to craft evidence-based spiritual interventions to directly improve health in a more fine-tuned sense than we do today?

MARY JO: While there is a beginning of evidence-based spiritual care, I think we are in the infancy stage. Within any population, there is enormous variation in what people need and want, and we are only beginning to understand the important variations and differences. More and more, we recognize the importance of customizing and personalizing care—and this will be critical with spiritual interventions.

RACHEL: Are there any particular well-being research areas regarding spiritual practices or ways of nurturing the inner life that you think will be most interesting to watch between now and 2021?

MARY JO: I'd like to see more research on how spirituality impacts overall well-being. I'd also like to see more research on what are called spiritual interventions, such as meditation, journaling, being in nature. Nature is an interesting one to keep an eye on. We know that as human beings we are innately drawn to nature—and nature is healing. A new field is emerging—nature-based therapeutics—that includes healing gardens, therapeutic landscapes, therapeutic horticulture, and green care or social farming. Spirituality is at the heart of nature-based interventions. That is an area I expect will grow.

“ Health care teams need to be prepared to provide spiritual care. While much of what we do in health care requires technical skills, providing spiritual care requires skills of deep listening, compassion, mindfulness, and presence. ”

RACHEL HATCH Research Manager, Ten-Year Forecast Program

Rachel focuses her research on how people nurture their inner lives and their relationships with others.





The self is a project, and people partake of a diverse diet of spiritual practices in order to enhance productivity.

In a growth scenario, people nourish their inner lives as a proactive strategy to keep their outer lives bustling, with minimum “system downtime.” Bodies are seen as instruments of productivity, and the winners in this world know how to fine-tune their bodies for optimal performance. Moreover, they know how to cultivate rich, healthy inner lives with a minimal investment of time, effort, and money. Spiritual practices are increasingly dissociated from tradition and seen as tools for achieving personal health and well-being goals. Personalized religion grows as people combine practices from across traditions based on desired benefits. Spiritual practices for health diffuse through the workplace and in online affinity groups and communities of self-improvement as diverse as new mommies and people recovering from bariatric surgery.

What's driving this future?

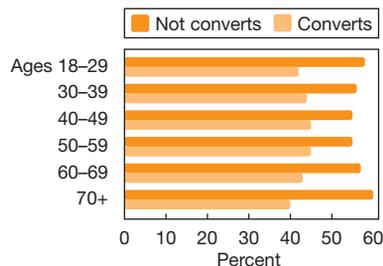
Rise of the fluid religious identity

Through their U.S. Religious Landscape Survey and beyond, researchers at the Pew Forum on Religion and Public Life have surveyed 35,000 adult Americans about religious affiliation and have found that religious identity can be fluid. The study found that 44 percent of those surveyed had changed religious affiliation at least once, and many change religions more than once. People are becoming curators of spirituality, sometimes drawing from multiple traditions.

New opportunities to combine practices for optimal productivity

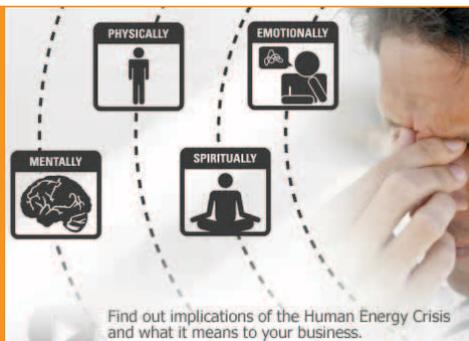
Human performance consulting firms are already calculating spiritual engagement as an important dimension of assessing energy and performance at work. From another angle, the Dalai Lama is hosting conversations such as “Buddhism and Neuroscience: A Discussion on Attention, Mental Flexibility, and Compassion.” As understanding of the links between spirituality and domains such as science and business expands, the growth scenario provides opportunities to combine well-being practices.

People Who Have Changed Religion



The Pew Forum on Religion and Public Life found that religious identity in the United States is fluid—44 percent of U.S. adults surveyed had changed affiliation at least once.

religions.pewforum.org



The Human Performance Institute, focused on helping leaders expand their energy and perform at their personal best at work and home, includes assessments of spiritual engagement.

hpinstitute.com



Technology offers tools to enhance spiritual well-being in a world of constraint but also challenges us to find time to turn off.

In a world of constrained resources, some of the most innovative but controversial practices involve using technology to mediate spiritual well-being. For instance, apps and other technologies offer persuasive nudges and advice to guide us toward taking better care of our inner lives, including, at times, reminders to take breaks from technology. Over the course of the decade, these efforts lead to more sophisticated forms of human-computer interaction aimed at enhancing our spiritual health and well-being. For many people, taking a break from always-on technologies becomes a means to reduce stress and improve happiness, and these sorts of techno-spiritual vacations offer low-cost ways to manage the inner life.

What's driving this future?

A new frugality imperative

In the spirit of stretching existing resources, mobile spirituality and techno-spiritual practices will provide frugal ways of cultivating well-being. Some of these methods will be participatory, while others will leverage anytime, anyplace technology to turn spare moments into opportunities to subtly enhance well-being. Imagine, for example, using a picture of Buddha as your smartphone screensaver to serve as a constant reminder of mindful living throughout the course of any given day.

Attention to the dangers of being always on

As mobile phones and computers have increased the extent to which many of us are always on and connected, a small but growing group of technologists—such as Soren Gordhamer, founder of Wisdom 2.0—has begun exploring how to inject spiritual wisdom into our use of technology so that we don't forget our inner lives. Such innovators will lead a push to ground our use of technology in presence, awareness, and wisdom in order to improve the quality of our communications and our overall well-being.



The Wellscapes app developed by the University of Minnesota Center for Spirituality and Healing invites users to “tap into the healing power of nature by taking five minutes to immerse yourself in stunning nature videos.”

csh.umn.edu



The Wisdom 2.0 series of events in Silicon Valley explores how we can live with deeper meaning and wisdom in our technology-rich age.

wisdom2summit.com



In a volatile world faced with cascading serial and local collapses, the role of spiritual practices and communities as sources of sanctuary and refuge is elevated.

In a world of complexity and collapse, the body must be an instrument of productivity to scrape together whatever paid work can be found along with providing for one's family in a dog-eat-dog world and thus must be defended against the cumulative health and well-being impacts of stress. In part, spiritual practices offer a low-cost health option—one of the few options in reach for many people. Meanwhile, spiritual institutions offer a uniquely safe and welcoming space to tend to the inner self. Over time, these spiritual efforts don't just offer means to cope with stress; spiritual markers—such as religious certification of foods—become critical and trusted indicators of safety.

What's driving this future?

Increased migration leading to spiritual blending and conflict

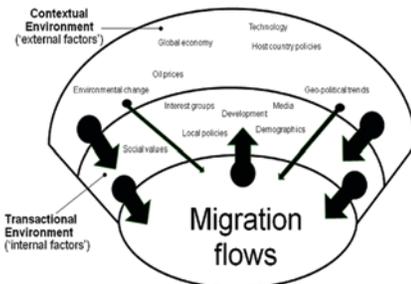
As economic opportunities decline regionally, people facing hardship will increasingly migrate out of areas of collapse toward remaining pockets of economic opportunity. This uprooting will not only create further spiritual blending but also sharper spiritual divides, leading to the formation of spiritual diasporas and affinity groups.

Growth of religiously based consumption

In a world of reduced choice and unreliable resources, available products will have few safeguards, especially in the realms of food and personal care. People will look toward religious filters to ensure safety, and consumption of religiously based products such as halal cosmetics or kosher food will grow.

Conception of the inner self as refuge

In a world of volatility, uncertainty, complexity, and ambiguity, many people will retreat to the inner self as a defense against the external world. For others, a richly cultivated inner life could be the foundation for responding creatively to the challenges of living with collapse.



Research from Oxford's International Migration Institute points toward broader challenges in the environmental and economic landscape as catalysts for migration.

Global Migration Futures, International Migration Institute



Photo: Flickr user k:snyder

According to data from Mintel, only 15 percent of people who buy kosher do it for religious reasons; nonreligious consumers buy kosher foods for safety and health reasons.

For Some, 'Kosher' Equals Pure, nytimes.com



Practices to nurture the inner life are co-created from the bottom up, blending approaches from spirituality and health care.

As spiritual practices become increasingly blended and remixed, this reimagining of spirituality inspires bottom-up efforts to co-create new definitions of spiritual health and well-being. Driven, in part, by communities of bloggers known as “theoblogians,” informally trained spiritualists create spiritual systems in tune with local environments and needs—aimed, more broadly, at helping people create and manage holistic and personalized definitions of well-being. As these informal spiritual systems are co-created and tweaked, many of them blend methods to enhance physical and mental health. In response, many traditional religious institutions explore increasingly formal and involved efforts to integrate health and well-being initiatives into their work.

What's driving this future?

Entry of spiritual communities into the well-being space

As the focus shifts from health toward well-being, traditional care delivery models focused on physiological health will be augmented by local spiritual communities that are better equipped to participate in the well-being space. Initially, many of these efforts will involve small-scale distributed networks that emphasize preventive care and capacity building. Over time, these preventive efforts will become increasingly central components of traditional health and medical practices.

Rise of theoblogging

As a response to the failure of current religious institutions to meet people’s needs in a time of dynamic change, communities of bloggers will collectively forge new spiritual practices, and in some instances even entirely new theologies, in transparent public forums. These forms of peer-to-peer support for the inner life will play a growing role not just in spiritual and mental health but also in shaping how people understand and create a sense of holistic well-being in their personal lives.



A London church offers itself as a quiet place in the city where people can improve their well-being by reducing stress.

Jason Tester, IFTF



tallskinnykiwi
SOME FRESH, CLEAR, WELL-SEASONED PERSPECTIVE ON WELLBEING AND MEDIA

Theoblogian Andrew Jones is working with others in the Emerging Church movement to form a new epistemology through a transparent, conversational form of production.

tallskinnykiwi.typepad.com

Insights: why spirituality matters

Over the next decade, as the links between a rich inner life and positive health and well-being outcomes become clearer, several new strategies will emerge to use spiritual well-being to enhance health.

o **Spiritual health care delivery evolves**

Within the broader health care context, spiritual communities have long played a role in health care delivery. As a more evidence-based spirituality emerges, religious health systems will be able to build on some of their current initiatives to further connect spirituality and health. Similarly, other hospital and health systems will begin experimenting with ways to help patients improve health outcomes by enhancing and nurturing the inner life.

o **Technologies enhance personalized spiritual health practices**

Over the next decade, both the emotional costs of technology dependence and opportunities to leverage technology to enhance spiritual well-being will become increasingly measured and understood. As this understanding improves, a variety of efforts to minimize the negative impacts of technology use and maximize their spiritual health value will emerge. In many instances, these technologies will enable people to design and create much more personalized definitions of holistic well-being.

o **Spirituality-based initiatives become zones of combinatorial innovation**

Fluid attitudes toward spiritual practices, coupled with more precise tools to measure the effects of various practices, will turn spirituality into a zone of combinatorial innovation, where some of the most transformative initiatives will stem from connecting and combining previously unrelated concepts. Finding and leveraging connections between spirituality and physical health—such as the perceived safety of religious food and the physiologic effects of meditation—will point toward previously unseen intervention points.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop spirituality-based initiatives in the coming decade.

Motivation may shift outcomes

While research has pointed to quantifiable health impacts of intentional spiritual practices, when stripped from their motivational contexts those practices may not offer health effects of the same magnitude.

Decontextualizing spirituality may provoke a backlash

Even if there is strong evidence in favor of adopting certain spiritual practices, there is also a strong potential for backlash and anger over the separation of spirituality from its traditional context.

Key resources

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BODIES

why **time** matters

Starting from sleep cycles and other basic biological patterns, scientists have vastly expanded the inquiry into the relationship between time, biological clocks, and well-being. The burgeoning discipline of chronobiology is laying the groundwork for new medicine, new technologies, and new strategies to use precisely timed interventions to enhance well-being. Over the next decade, basic research in chronobiology will translate into dozens of practical applications that will harness or mimic biological clocks to address issues as diverse as antibiotic resistance and mental productivity. These innovations will, in turn, reshape our understanding of our bodies and time—and create a new practice of health management that is distinctly personal.

Focused at the **scale of bodies**, this forecast perspective explores emerging responses to the question of **why time matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that timing in our bodies could reshape health and well-being.

Periodicity

Improved understanding of body clocks

Many functions in the human body, from sleep to digestion to cell reproduction, exhibit rhythmic cycles that are linked to environmental signals. The 24-hour light cycle is the master cycle for sleep and wakefulness, and this circadian rhythm is the basis for many other cycles. Diverse biological clocks govern the functioning of the liver, lungs, pancreas, spleen, and even skin. Hormone release and cholesterol synthesis both follow a daily periodic schedule. At the level of the smallest clocks, individual cells have distinct rhythms for cell division, gene expression, protein synthesis, and the regulation of metabolism. Over the next decade, these patterns of periodicity, which form an intricate foundation for human well-being, will be more clearly understood.

Genes and bacteria

New time-targeted medicines and medical treatments

If well-synchronized clocks are the key to whole-body wellness, chronobiology will have obvious implications for diagnosis and treatment of disease. Already doctors are beginning to prescribe regimens for taking drugs for eczema, asthma, ulcers and osteoarthritis. Unlike healthy cells, cancer cells divide randomly. So if chemotherapies are administered when healthy cells are resting, rather than dividing, the drugs will spare healthy cells and target cancer cells. Similarly, studies mapping the clocks of the bacteria that make up 90 percent of cells in the body are aiding the development of next-generation antibiotics. Nonpharmaceutical interventions such as light exposure, regularization of eating and sleeping cycles, and specific nutrient intake schedules may prove to be effective treatments for obesity, depression, and type 2 diabetes.

Biological time

Personalized health practices based on chronotype

The multitude of clocks that keep the body cycles in sync are genetically determined, and different people have different clock profiles—or chronotypes. While research into chronotypes is still in its infancy, the high-resolution view of human timekeeping will gradually lead to personalized schedules of work, light exposure, eating, and dietary supplement and pharmaceutical use tailored to the make the most of each individual's distinctive network of biological clocks.

—Kathi Vian



expert voices **MARTHA MERROW**

KATHI: What is the scope of chronobiology today? How should we think about its impact on practices of health and well-being over the next decade or so?

MARTHA: Potentially every cell on the face of the earth has a clock. The clock is a fundamental biological process that is important in how we view every other process that we're studying.

We have people who specialize in working in the microbial clock. We have people who specialize in the cellular clock and people who specialize in working in the organismal clock, the behavioral clock, the metabolic clock. It's an incredibly broad field, and it's getting broader.

KATHI: How does this cellular timekeeping add up to health impacts and possibly health interventions?

MARTHA: We've known for a long time that glucose levels are under circadian control, but Joseph Takahashi at the University of Texas has recently shown that insulin metabolism and glucose metabolism are under clock control. Blood pressure is circadian: it goes up and down. It's higher at some times of the day than others. We also know that people who do long-term shift work tend to have a higher body mass index or BMI. The implications are that if you work against the clock, there are going to be substantial population-wide diseases.

My colleague Till Roenneberg and I published a paper in 2005 in which we coined the term social jet lag. This is the concept that if you use an alarm clock regularly to get to work on time, you're depriving yourself of sleep every day. You're getting up and doing things when your biological clock suggests you should be sleeping. Based on research with tens of thousands of respondents, we now know that you're much more likely to be using nicotine, alcohol, and caffeine if you have social jet lag.

KATHI: Is there an ecosystem of clocks? How do all these clocks interact with one another and their environments?

MARTHA: We are a collection of clocks that interact. On the very simplest level, we have individual cells. Cells come together to make organs. Most organs function as cohesive clock units. The liver is doing something that seems organized as a liver clock. The kidneys, eyes, and heart all have circadian rhythms. They all are taking different sets of signals from the environment to help them synchronize.

We used to think that with jet lag, everything lagged behind. Now we think that some things lag more than others. So the liver may be doing things at a time that may not be synchronized with when the kidney is doing things. And this all might be out of sync with when the brain is doing things.

Your kidney and your liver can be doing something completely different depending on what signals they are getting from within or outside you. For example, a non-shift worker would normally get food throughout the day. Food turns out to be a pretty good stimulus for our liver in terms of synchronizing when the oscillations and clock gene expression occur.

KATHI: Do you see us having the knowledge within the next ten years to be able to intervene directly to improve health?

MARTHA: Yes, I actually do. The strongest signal for the clock (in terms of behavior) is light, but we have been shielding ourselves more and more from light. As a society we've moved indoors. In our questionnaire, we ask people how much time they spend outside every day. Some people are outside literally for five minutes a day while others are outside for eight hours a day. But you can change the timing of your behavior by giving yourself relatively more light at some times of day than at others.

Martha Merrow is Professor of Molecular and Genetic Chronobiology at University of Groningen in the Netherlands.

She and her colleagues have been studying biological clocks at multiple scales to determine their implications for human behavior, health, and well-being.

A rule of thumb for anyone is, if you want to become an earlier chronotype—if you'd rather get up earlier and need the alarm clock less—you should expose yourself to very strong light early in the day. You also need to shield yourself from light at the end of the day.

We want to start to understand light almost as a prescriptive. We want to be able to say to someone, "Sit in front of this many lux of light at this time of day, and you will be able to shift yourself half an hour earlier a week." We don't have those definitions yet. That's what we're working on now. We hope in five years to have enough information to get at least half the population off alarm clocks. Right now 85 percent of the people who answer our questionnaire are using alarm clocks.

KATHI: How do you think today's chronobiology research will change the way we understand the complex nature of human health and human environments over the coming decades? What's the basic message for people in the health fields?

MARTHA: The basic message is that almost every process is modulated by the clock somehow. By taking this into account and by respecting this, we will do much better in terms of treating people and keeping them healthy.

Whenever I give talks to biologists, doctors, or academic groups, I always try to stress that I don't expect anyone in the audience to become a chronobiologist. However, I hope that they all take time into consideration when they set up their experiments and protocols. The reason is that that will take their error bars down from large to small. If every time they published a paper they included the time that they did the experiment, we could start to study everything in this fourth dimension, the time dimension, and not just look at it on a flat temporal scale.

“ The basic message is that almost every process is modulated by the clock somehow. By taking this into account and by respecting this, we will do much better in terms of treating people and keeping them healthy. ”

KATHI VIAN Director, Ten-Year Forecast Program

Kathi leads IFTF's Ten-Year Forecast Program, which is a broad scan of the emerging global environment, focusing on the intersection of new economic forces, changing environmental realities, and new social practices.





Time is increasingly understood as a function of biological processes that can be altered biochemically to improve productivity, expand our time spaciousness, and even extend our lives.

In a growth scenario, time is instrumental. We seek to master time and harness it to enhance our productivity. With increased understanding of the timing of biological functions at all levels, from the cellular to the behavioral, the same people who have experimented with Ritalin and Provigil to improve performance are experimenting with chronotherapies to fine-tune their time management strategies, optimize physical and mental performance, and enhance personal productivity. These early adopters are biochemically altering their nervous systems to achieve a sense of time spaciousness in the midst of pressing deadlines. Innovative medical practitioners and transhumanists are intervening in their clock systems in an attempt to lengthen their lives and stave off aging at the cellular level.

What's driving this future?

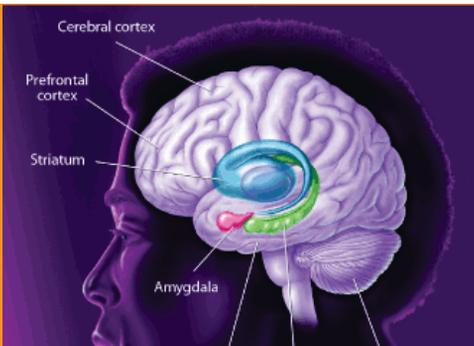
Understanding high-performance time

Neuroscience researchers, including David Eagleman and Warren Meck, are exploring the neurological basis for the perception of time in an attempt to understand why time seems to slow down for high-performing athletes, for experts engaged in their field of knowledge, and even for people with autism spectrum disorder. These studies are likely to lead to strategies for intentionally altering the perception of time, both behaviorally and pharmacologically, to bolster performance while producing the euphoria often associated with “time standing still.”

Engineering negligible senescence

Genetic research into biological processes of aging has identified the key role that the length of telomeres—the caps at the ends of individual chromosomes—plays in aging processes and diseases such as heart disease. A research team led by Nilesh Samani recently discovered that a gene called TERC is associated with telomere length. While telomere-based treatments for aging are a long way off, these studies may help clinicians understand why some of their patients experience age-related diseases earlier than others and may help them prescribe treatments accordingly.

signals



Catalin Buhusi and Warren Meck have pointed to the striatum as the “conductor” of the body’s orchestra of clocks.

sfn.org/index

DR. DAVE'S BEST
TELOMERE
EDGE PACKS
THE #1 HEALTH AND
ANTI-AGING SUPPLEMENT



Drugs that target telomeres are most likely decades away, but telomere research is already spawning anti-aging supplements.

Telomere Edge Packs,
Dr. Dave's Best



Time is recognized as a natural mechanism for regulating the functions of our organism at all levels, and testing, diagnosis, and treatment are targeted to specific chronobiological rhythms.

In a culture that values restraint and optimization, medical models and personal well-being practices are being adjusted for efficiency, with chronobiological research guiding the way. Schedules for medical interventions, from antibiotics to chemotherapy, are becoming ever more precise and customized, demanding adjustments in clinical routines and daily life. Meanwhile, it's no longer enough to walk for twenty minutes sometime during the day—now people schedule their walks to take advantage of the morning sun if they want to shift their body clocks to waking up earlier or in the afternoon if they need to work late on a regular basis. Paradoxically, this focus on precision timing demands more flexibility in the institutions of daily life, with more use of flextime, variable working shifts, and extended hours for medical services.

What's driving this future?

Growing emphasis on intervention timing

Basic and clinical research is driving a growing awareness of the optimal times for medical interventions in different organ systems as well as the importance of optimizing overall synchrony of the systems. Already thyroid hormones, and other hormones such as corticosteroids come with “morning only” labels.

Rising medical costs and the drive for efficacy

In a world where rising medical costs are on everyone's mind, it will become increasingly important to get the most out of every pill, every supplement, and every physical therapy session. Chronotherapy promises to deliver this extra efficacy. At the same time, it also promises to reduce side effects of pharmaceuticals and perhaps even speed new drugs to market as a result.

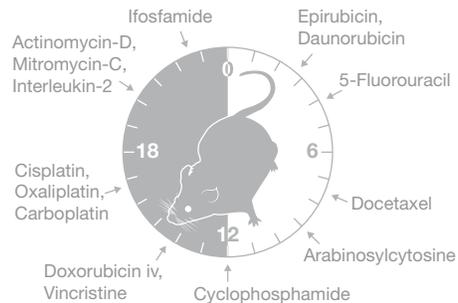
Development of tools for around-the-clock self-diagnosis

Just as medical and health interventions produce better results at certain times of day, diagnoses produce more accurate results when conducted at the right time—or throughout the day. The knowledge that test results vary significantly with time of day will hasten the development of tools for continuous self-diagnosis.



WakeMate is one of several new sleep-monitoring devices designed to awaken users at the optimum time.

geeky-gadgets.com



Studies have identified the least-toxic dosing times for chemotherapeutic agents in mice and rats.

Cancer Chronotherapy: Principles, Applications, and Perspectives



Time is understood as a function of cellular clocks throughout the living world, and disruption of these clocks is causing illness at all levels of living systems.

In a world on the brink of collapse, people in all kinds of circumstances find themselves engaged in activities that disrupt their natural biological clocks. Working in high-pressure or multiple jobs, they are often sleep deprived. Living in dense urban settlements, their nights are often lit up with activity. With inconsistent access to quality food, their digestive organs function out of sync. As a result of disrupted clocks, more people make unhealthy lifestyle choices, especially smoking and drinking. At the same time, the ability to learn, to process information, and to perform physical tasks declines, increasing their burden of stress. Even as chronobiological research points to medical solutions to clock disorders at the molecular level, few of those afflicted can afford the fine-grained diagnostics necessary to pinpoint malfunctions.

What's driving this future?

Disrupted rhythms and social jetlag

Diseases and maladies linked to disrupted sleep cycles are becoming more prevalent as institutional schedules interfere with the natural chronotypes of workers who use an alarm clock to get to work on time. Those with social jetlag are using more nicotine, alcohol, and caffeine.

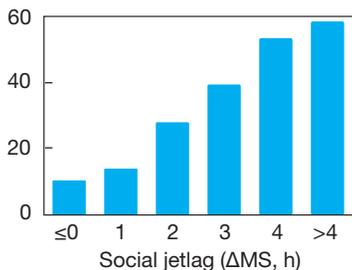
Increasing complexity and distorted perception of time

In a world of increasing complexity, perception of time becomes distorted. One study of the relationship between time, complexity, and stress found that deadlines distort time perception to make complex problems seem closer in time.

Misalignment of predator-prey cycles

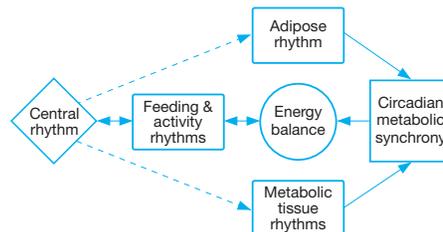
The complex interdependencies of biological clocks have been demonstrated by studies that show the impacts of climate change on cycles of plants and animals. Predators that depend on prey for food may find slim pickings if the reproductive cycle of the prey is disrupted. Such asynchronies could disrupt not only entire food chains but also the bacterial ecosystems of the human body.

Percent of Smokers with Social Jet Lag



Researchers at Ludwig-Maximilian University found a strong correlation between social jet lag and smoking.

Social Jetlag: Misalignment of Biological and Social Time



Recent studies suggest that circadian cycles regulate energy balance in the body, and dysfunctions or disruptions of those cycles may lead to obesity and type 2 diabetes.

nature.com



Time is understood as a function of networks of biological cycles, and institutions are fine-tuned to work in harmony with those networks.

As we enter the 2020s, a leading-edge group of time reformers begins to reorganize our social, political, and medical systems. These reformers seek to bring our institutions and practices—from health care to law—into alignment with our radically new understanding that time is not an objective phenomenon of the physical world but is instead the result of coordinated communication across networks of the millions of cellular clocks that make up our nervous systems. In this world, diseases ranging from schizophrenia to Parkinson’s are seen as resulting from communication timing disorders. So are many instances of criminal and antisocial behaviors, which are increasingly treated medically rather than in the justice system. Meanwhile, games and media deliberately distort timing to play with experiences in which time appears to flow backward and forward, and even to stand still.

What’s driving this future?

Expanding practice of time-stamped research

Martha Merrow and other chronobiologists are preaching the idea that our views of the world would change if we conducted experiments with precise time-stamping of the events we’re measuring. These efforts will gradually lead to a more dynamic view of everything from epidemiology to social psychology.

New understanding of chronopathologies

It is becoming increasingly clear from brain research that many physical and psychological disorders involve a breakdown in the brain’s timing systems. Scientists are looking for explanations for epilepsy, schizophrenia, Parkinson’s, and Huntington’s disease in timing errors.

Experiments in manipulating the flow of time

Stanford’s Neuroscience Laboratory for Perception and Action is demonstrating that “brains do not passively track time; they actively construct it.” The lab’s experiments suggest that our perception of the timing of an event lags behind the event by about 80 milliseconds, and that we can manipulate our motor experience of that interval to make time appear to flow backward.

signals



To improve learning, the National Sleep Foundation advocates for later school start times.

sleepfoundation.org

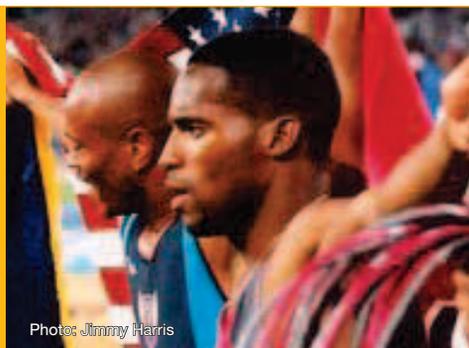


Photo: Jimmy Harris

Gold Medalist Ato Boldon says, “Sprinters believe that—someday—somebody will run the 100 meters and the clock will read 0.00.”

en.wikipedia.org

Insights: why time matters

Over the next decade, opportunities to align medical interventions, well-being practices, and even workplaces with our internal body clocks will open up new opportunities to build capacities for well-being.

o Understandings of timing lead to new interventions

New platforms and protocols for health care delivery will improve outcomes by matching the timing of diagnostics, surgery, physical therapies, and pharmaceutical interventions to specific clock-linked functions in those being treated. Health care models will shift from a focus on risk and risky health behaviors to building personal capacities for well-being, where well-being is defined as being in sync both internally and with our natural and even institutional environments.

o Chronobiology enables personalized nutrition

Convenience foods will take on an entirely new meaning as our pursuit of well-being takes personal chronobiology into account. In a world where science can tell us about specific nutritional needs at specific times of day—customized for individual chronotypes, disease states, and work requirements—convenience won't mean anytime/anywhere. It will mean the right food in the right place at the right time of day.

o Time management reshapes workplace wellness initiatives

As chronobiological research gives us formulas to fine-tune our well-being by focusing on the “when” as much as the “what” of healthy behaviors, the most sought-after workplaces will be those that can support healthy diurnal schedules. These workplaces will almost certainly offer more flexible working hours. In addition, look for new workplace designs that use light (ambient light, task light, and device light) to help people achieve optimum alignment of their biological clocks.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop time-based initiatives in the coming decade.

Personal chronobiologies conflict with institutional schedules

Millions of highly personalized time strategies may lead to new kinds of demands on institutions. While people may seek to optimize their food, work, and health strategies to their personal biological clocks, striking a balance between accommodating personal chronobiologies while maintaining the needs of institutional schedules will present potential challenges.

Senses of time become disparate

As technology integrates bio-clocks into computing and time measurement, we will be entering a world where what time is will feel less standardized. This shift will challenge everything from our understandings of health and mental performance to our legal systems.

Key resources

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why **identity** matters

Currently, digital health focuses on capturing medical data through electronic records and making information accessible through networked systems. Over the next decade, our quality of life will fundamentally improve as data sources—from traditional medical records to phone logs and social networking profiles—create rich digital representations of our individual health and well-being practices. These sources won't just point to individual concerns; they will highlight hidden connections, uncover common affinities, and provide a basis for networked efforts to make sense of increasingly complex data streams. Enhanced mixed-reality tools, which blend physical and digital worlds, will form the basis of efforts to understand and communicate abstract health data in ways that enhance individual and collective well-being and long-term health.

Focused at the **scale of networks**, this forecast perspective explores emerging responses to the question of **why identity matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that efforts to shape and reshape health and well-being.

Networked repositories

Identifying connections and places to act

The Internet of Things, fueled by cheap sensors and computing power, is enabling billions of objects and products to be tracked on the Web and will allow organizations to assess how we actually use products and items. As our physical and digital worlds blend, our health information will be scattered across mobile devices, institutional servers, and the cloud and this will ultimately motivate individuals and networks to create open-source repositories where they own, control, and share their data. These networked information spaces will create new opportunities to look for connections between people, places, and activities and identify behavioral and other health interventions.

Networked discovery

Harnessing new ways to comprehend our health

The proliferation of mobile technology, personal health devices, and other self-tracking tools isn't just enhancing personal health. Over the next decade, these data streams will become subjects of social interaction, ushering in a world of networked health discovery. In particular, these tools and services will turn toward enabling individuals to connect with others who share the same health condition so they can help each other make sense of more complex health information, for instance genetics and epigenetics. As findings emerge from investigations such as the International HapMap Project, a networked genome mapping project, these findings will transform how people understand the meanings of their biological data.

Health sentience

Sharing our physiological and emotional states to enhance connection

Using mixed-reality games, real and virtual coaches will help us manage commonplace and acute health concerns ranging from weight loss to PTSD. As research scientist Skip Rizzo and his colleagues at the USC Institute for Creative Technologies assert, we will receive online guidance from artificially intelligent "virtual buddies" to "develop more positive health-related thinking and behavior." Health coaches, both virtual and human, will rely on smart physiological sensors that accurately detect, convey, and share our physical vital signs and emotional state to help us achieve our well-being goals.

—Brinda Dalal



expert voices **ALEX OLWAL**

BRINDA: How do you view the future of mixed reality and health care?

ALEX: Mixed reality is a way to take information that our technology, typically the computer, can sense and present it in more natural ways by using sensors and displays that allow us to create a blend of the real and the virtual. In the case of medical applications, this could allow us to simplify the understanding of medical phenomena that happen inside us. The notion of X-ray vision could become a reality under certain conditions. And as a lot of ideas from the Quantified Self movement become mainstream, combined with low-cost and widely available sensors, we also want ways to visualize and interact with those data in real time.

In our research, we are pushing the notion of unobtrusiveness—we avoid displays that interfere with, reduce, or alter reality. We want something that is seamless and adds just the right amount of information to your environment in the right context.

BRINDA: How did you use these concepts in the OldGen project?

ALEX: In that project we personalized mobile phones for older adults by building a separate user interface adaptive to each user's capabilities. When someone has an issue with vision, you perhaps want to scale up text and graphics but keep all other functionality. When someone else has a problem with cognitive ability, you may want to reduce menu hierarchies or reduce functionalities to a bare minimum. With assistive technologies, the industry commonly creates one-size-fits-all devices, such as generic cell phones for seniors using big buttons and large fonts. But we need to take into account that the differences in seniors' individual capabilities and limitations are even greater than for other users.

BRINDA: How will immersion in blended-reality environments affect our bodies? Will fatigue, eyestrain, and repetitive use injuries be exacerbated?

ALEX: In our work, we try to use the best possible technology that will address these issues and try to avoid displays that cause the problems you describe. Information overload is one motivation for using augmented-reality displays because you don't have to look at many places at the same time.

For instance, when someone is operating industrial machinery, there is often a peripheral vision display that shows information. At the same time, the operator wants to look through the safety glass to see how parts are moving inside the machine. Using our ASTOR system, we built an interface for an industrial lathe that took all the data relevant to the operator and overlaid those in 3D inside the machinery. We wanted to preserve the direct view through the glass and render the minimum possible graphics to communicate the necessary information. We also wanted the ability to quickly disable this information, so just by stepping to the side, operators can step out of the augmented viewing zone to get the direct view of the machinery.

Alex Olwal is a researcher at the MIT Media Lab. His research (www.olwal.com) focuses on interaction techniques and technology, including augmented reality, spatially aware mobile devices, medical user interfaces, ubiquitous computing, touchscreens, and novel interaction devices and displays.

BRINDA: Let's take a minute to imagine ten years into the future. What might digital well-being look like?

ALEX: Patients will be able to have more influence and control over their health. You will see a lot of Web sites that will allow you to do low-cost genetic testing for predictions. More important is the notion of getting access to diagnosis and treatment on a need-to basis, without flooding the health care system. I'm thinking of scenarios where you can do all sorts of diagnoses from your home, enabled through computer vision and other sensing techniques. You can capture data about symptoms and conditions over time, and the technology helps boil those down to the most important things you want to communicate to a medical expert. In the future, it may be enough to consult with an expert for five minutes when all this rich data is available.

Ten years from now, we'll see a plethora of displays and sensors that will provide us with the ability to steer information as we consume or interact with it. We'll see handheld projectors and displays that are optically transparent, like a shopping window that you look through that can superimpose information on items behind it. Medical examples include surgery rooms or a doctor's office where specialists will be able to look into and through your body to see things about your health that are not evident just through a scan or an ultrasound, so that you can have a real-time discussion about what the internals look like and what processes are happening. That may be very valuable.

BRINDA: Who will be driving this sort of adoption in health?

ALEX: I think the user will be the one who decides and drives what leads to widespread adoption. One example is the augmented-reality applications on mobile phones that became popular one or two years ago. You don't see a lot of people walking around on the streets holding up their phone to get overlays of their camera image. The underlying concepts are compelling, but the technology is not necessarily socially practical. We can't expect that someone will develop policies for when such supplemental displays should or should not be used. People will decide what works and doesn't work for them in an organic way.

BRINDA: What have you learned about people who use your technology. How has it helped them to change their views of health?

ALEX: The most striking aspect is how completely different everyone is from each other. I think that's something we often forget. We think of all these groups as a gray mass of similar individuals, but in fact everyone has different interests, capabilities, constraints, and experiences. It's very difficult to address all of these unless we are aware of them. That is why I believe that philosophies like Design for All will become increasingly important in the future.

“ We want something that is seamless and adds just the right amount of information to your environment in the right context. ”

BRINDA DALAL Research Director

Brinda focuses her research on situational well-being, especially environmental and affective health and health privacy in the “Internet of Things.”





Ubiquitous computing turns homes, offices, and city streets into spaces for contextually relevant initiatives to enhance well-being.

In a growth scenario, cheap sensors and the Internet of Things become tools for measuring, communicating, and understanding our health and well-being. Families use e-textiles and consumer products embedded in their homes and offices to increase awareness of their physiological and cognitive responses to daily events. Clinical teams use mixed-reality applications to strengthen people's adaptive capacities, for both mental and physical health. While these tools and services offer opportunities to create incredible databases for uncovering new strategies to enhance well-being, these on-the-body and in-the-home sensors spark increasingly intense debates about whether objects should be tracked in people's homes. This controversy sometimes limits efforts to harness the potential value of these tools.

What's driving this future?

Rise of mobile health tools

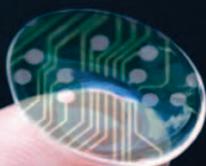
Access to quality care in resource-poor locations is now within reach of a cell phone tower. Already, phone-based behavior change and health initiatives have shown strong success. Over the next decade, health care delivery for chronic and infectious diseases will leverage camera-based imaging and mobile video as tools for diagnosis, data-collection, and monitoring and for provision of confidential medical advice.

Increasing affordability of technology

As sensor and computing technologies become cheaper and more flexible, embedding intelligence into basic commodities such as clothing, as well as infrastructure, for example, floor boards and building walls, will become increasingly common. These tools will lay the groundwork for precise, contextual measurements of how places, times, and other subtle influences shape our well-being practices.

Expansion of evidence-based approaches

Evidence-based medicine—where peer-reviewed compilations of the latest clinical research and medical guidelines inform medical diagnoses and administrative policies—will expand into the world of well-being. Programmers will draw on evidence-based databases to construct mixed-reality decision tools that help families assess their well-being options.



Dr. Babak Parviz has developed contact lenses with semitransparent embedded electronics for biosensing body chemistry.

Contact Lens: Future Platform for mHealth?, mobihealthnews.com



Mobisante has created the world's first smartphone-based ultrasound imaging system.

mobisante.com



Mixed reality turns extreme reputation management into a significant health and well-being activity—and avoiding leaving a digital trail becomes a means to ensure choice.

In a world of financial constraint where institutions and individuals are trying to make do with less, presenting a healthy digital identity becomes a critical part of gaining access and acceptance into critical health institutions. Employers and governments reduce insurance costs by moving health diagnostic devices into the home and outsourcing health care to international telehealth practitioners. This desire to reduce costs also drives behavioral advertising intended to nudge people toward better health. In response, individuals increasingly choose to buy food, medications, and supplies with cash to avoid leaving digital trails that health insurance companies can track. Others rely on reputation service providers and content crawlers to redact and delete potentially incriminating health information in the cloud.

What's driving this future?

Outsourcing of health care

Already, a handful of American health insurers have experimented with covering medical tourism and telemedicine in an effort to lower costs. As treatment costs continue upward, consulting with physicians and nurses in multilingual call centers in Bangladesh and elsewhere will become an increasingly common first-line treatment strategy.

Privacy advantages of digital currencies

Mobile payments are convenient but leave a digital trail. In response to privacy concerns, libertarian cryptographers around the world are promoting the use of alternative currencies such as Bitcoin that enable anonymous, encrypted transactions. These kinds of untraceable transactions will become increasingly common in a world of individuals seeking to maintain choice in spite of constraints.

Growth of digital redaction services

In a world where the assumption is that digital records represent complete and accurate depictions of our current reality, controlling those stored records becomes increasingly contentious. Redaction services for distributed information stored in the cloud are growing rapidly. The implications for family health records will be substantial: Who owns what data and who can redact it?



ID Shield offers cloud-based redaction services to organizations.

Extract Systems Brings Advanced Redaction and Data Capture to SharePoint Environment, PR Web



Bitcoin is to legal tender what BitTorrent was to digital music: shareable, compelling, and legally questionable.

bitcoin.org



Digitization of health information spurs new kinds of identity crime—and maintaining a secure health identity becomes central to safety and personal health.

In a world of health and resource insecurity and collapse, digital health security becomes increasingly central to well-being, even as it gets weakened systematically. Digital footprints become a next-generation form of security to clear those who try to access spaces and resources. By 2021, many children under age 10 in Asia have microchip implants, and in Western Europe, children age 16 and younger have digital health dossiers that contain rich histories, from tests and medications to mental health events. As health care goes virtual, cyberhealth breaches abound. Hackers use data snooping techniques to collect data from people’s homes and deluge them with rogue information. Child identity theft soars as family health records, stored on different computers, are compromised, creating a world where few feel safe—in either physical or virtual space. Efforts to crowdsource public and private security proliferate as a way to fight back.

What's driving this future?

Surveillance games becoming commonplace

Recently, shopkeepers and pub owners in the United Kingdom opened their closed-circuit security video feeds to the public, inviting subscribers to hunt for crimes in real time. These sorts of efforts will become increasingly common as individuals and families look to use collective intelligence to identify and punish people who are acting in bad faith.

Ease of targeting less secure identities despite hacker ethics

In China, prominent former hackers have created an ethics manifesto, requesting that hackers protect the privacy of children, abstain from profiting from identity theft, and turn their skills toward safeguarding China’s information security borders. In a collapsing economy, however, children, whose identities are less protected and secure, may become easy targets. As a result, cyberhealth systems will be repeatedly compromised.



Internet Eyes, a start-up based in the United Kingdom, pays subscribers to watch live security camera feeds and spot crimes such as shoplifting.

Internet Eyes Will Pay You to Watch Security Camera Feeds, geek.com



42-56 Washington A...

Assess

There are more than 100 offenders registered as living or working within 5.0 miles of this location.

Sex offender tracking applications such as StaySafe are becoming increasingly popular forms of crowdsourced security.

StaySafe, HandStorm Inc.



Mixed reality offers high-resolution tools for understanding, enhancing, and sharing physiological experiences to heighten collective well-being.

Augmented awareness and mixed reality take preventive care to new levels. During office visits, patients can see into their own bodies using consumer-level vascular imaging devices while they discuss symptoms with their medical professionals. As such tools gain precision, people can view their own physiological responses in real time, and these reactions become shareable so that people can sense and reenact the emotional states of others. Advances in techniques such as deep brain stimulation also make it possible to skillfully modulate responses to turbulence through nanomedical tools and mood enhancements. By transforming these individual and collective data streams into inputs for art and expression, designers simulate people's vital signs; performance artists use sensory indicators to portray emotions, amplify corporeal responses to life events, and even enact the end of life.

What's driving this future?

Technological manipulation of physiological states

Digital health innovations will be inspired by therapies such as deep brain stimulation (DBS). DBS is used to treat patients who experience extreme symptoms of Parkinson's disease, chronic pain, and psychiatric conditions. Implanted electrodes emit electrical pulses that stimulate the brain and help people regain some motor control, reduce pain, and assist in decision making. Over the coming decade, these direct manipulations of our brains and other embodied experiences will form the basis for a variety of health interventions.

Development of platforms for sharing realities

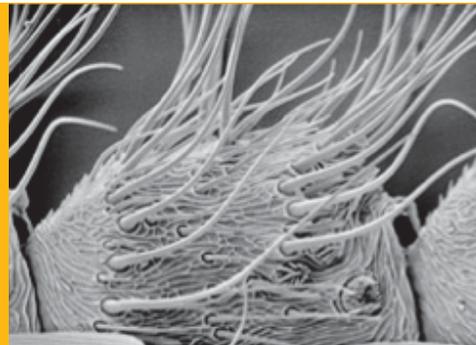
Mixed reality pioneers are already focusing on using the tools of seamless virtual worlds to create platforms for shared experience. For example, in the Mixed Reality City seminar/studio at the Harvard Graduate School of Design, students create experimental spaces aimed to alter how we see, hear, feel, and experience people, environments, and materials. As these efforts migrate from academic labs into our environments and lives, they will offer platforms for creating and sharing communal health and well-being experiences.

signals



XWave helps people hone their ability to focus and concentrate by giving them biofeedback via their smartphones.

plxwave.com



In their "Crossing Wires" installation, artist Raewyn Turner and scientist Richard Newcomb combined installation art and molecular chemistry to illustrate olfactory sensors.

Plume-Raewyn Turner and Richard Newcomb, intercreate.org

Insights: why identity matters

As our digital health trails become increasingly comprehensive, many of the most effective approaches to understanding this data will not be individually focused but will instead turn this data into objects for sharing and creating new collective experiences.

o **Open data systems facilitate new understandings**

As more and more diverse sets of information—such as credit card statements—get integrated into digital health records, people will increasingly want to be able to control how their data is used, stored, and shared. Systems that give users this kind of control—open data systems—will become the most robust databases and ultimately the most useful source of data for mining to identify new kinds of targeted health interventions.

o **Integrating deep analytics with mixed reality results in new tools**

Emergent understandings of health, including collective metrics such as well-being indexes and advances in life sciences such as epigenetics, will form the basis of some of the most creative and successful mixed-reality health interventions. These kinds of efforts, such as mixed-reality apps that enable people to visualize the effects of place on their bodies, will help people make sense of and engage with their personal and family health.

o **Mixed-reality tools create opportunities for collective experience**

Mixed reality is making it possible for people to share virtual versions of their health and well-being experiences with others. Mixed reality tools will also be used to alter event venues and other places to create collective experiences of the effects of place on health. In both cases, harnessing the social power of mixed reality will be critical to using it as a means to enhance well-being.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop identity-based initiatives in the coming decade.

Information overload

While new information and mixed reality tools offer incredible opportunities to understand and intervene in individual and family health, these streams of data threaten to overwhelm our capacities to grasp which interventions really matter.

Gaps between data and experience undermine the credibility of information

Increasingly, our health data may indicate that an individual has health problems even though he is not actively experiencing them. This perceptual gap may cause people to doubt the relevance and accuracy of critical health information.

Key resources

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why **trust** matters

As health consumers shift their focus from narrow definitions of health to the broader landscape of well-being, they are also expanding their health practices beyond their bodies to their networks. Much research has already shown the potential health and happiness benefits of a healthy network, and over the next decade a host of new network practices promise to build personal well-being by enhancing the well-being of extended networks. These strategies emerge from new models of network sharing, often called the collaborative economy. Based on barter, reputation, and trust, this network economy will power everything from collective caregiving efforts to health care decision making. Strategies for sharing knowledge, experience, and tools will provide security in the face of personal and environmental challenges. Ultimately, new ways to measure well-being will emerge.

Focused at the **scale of networks**, this forecast perspective explores emerging responses to the question of **why trust matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that trust in our networks could reshape health and well-being.

Sharing risks

Emergence of collaborative resilience networks

Any number of risks—ranging from the possibility of sudden disruptions of water and energy supplies to the ongoing challenges of aging and illness—threaten to strain and overwhelm traditional health support systems. Collaborative networks are emerging as a way to build personal and collective resilience by sharing these risks. With new forms of time banking, for example, networks can build a reservoir of human resources for caregiving unbound by family relationships and geographical location. By enabling new kinds of transactions among strangers and aggregating tens of thousands of microcontributions, these networks will build entirely new capacities for managing risk.

Sharing experiences

Growth of common bonds and resources

Sharing experiences may prove even more important than sharing risks in building the common bonds of well-being. Already, sharing of user-generated data—about personal health as well as the built environment—has become an important strategy for pursuing health and well-being. People are becoming increasingly willing to share resources—homes, cars, and everyday objects—as well. Sharing information and resources will come to be seen as a means to create common bonds that produce stronger social networks and help people address health and well-being needs as they arise.

New metrics

Creating measures of network well-being

Recent research has found that communities where there are high levels of trust and bridging social capital—that is, connections between strangers and different groups—tend to have significantly higher measures of subjective well-being, lower crime rates, and fewer social problems than communities where trust is fractured. And individuals who trust others and feel connected socially tend to be happier and live longer, healthier lives. As these links become better understood, levels of social trust, collaboration, and sharing will become key metrics for tracking subjective well-being. Additionally, improving trust and sharing through civic engagement and other social tools will emerge as a domain of public health.

—Bradley Kreit



expert voices **WOUTER POORTINGA**

BRADLEY: Describe some of the ways in which community cohesion and social trust impact health and well-being.

WOUTER: There is this idea that when you have a lot of community cohesion or a strong bond within a certain community, it improves health. If there are a lot of strong relationships and people help each other out, that provides benefits not only to the individual receiving help but also to the community itself. If you look across the literature, there is a good amount of support for that idea.

If you have many friends in the neighborhood, you benefit from it yourself because you get a lot of support; people help you or you help other people. It gives you a good feeling, which contributes to your well-being. But people who have fewer social relationships in the neighborhood also profit from those links. There are different theories about how that works, but that is something that is very difficult to study and it hasn't really been shown yet how it works.

BRADLEY: How do you measure these improvements? What specific aspects of health does being in more connected, trusting environments improve?

WOUTER: Personally, I tend to look at the self-rated health measure, which is a very generic measure of how your health is currently. Is it excellent, is it good, is it fair, is it poor, or is it very poor? I like that outcome measure because everybody can answer it. In terms of validated health measures, there is physical health, things like cardiovascular disease or respiratory disease or even mortality.

No matter what kind of outcome measure you use, it tends to be associated with social capital. When you go to neighborhoods with a high level of social cohesion, people tend to have lower levels of mortality as compared to neighborhoods with lower levels of social capital. Mental health, physical health, mortality, but also success rates at school and crime rates are influenced by social cohesion. There is a very clear link there because it is really well known within environmental psychology that if there is a lot of social interaction, there is also more social control. Offenders are less likely to offend in those areas.

BRADLEY: How do different kinds of networks influence health? For example, what are some of the differences between tight-knit, closed networks and more open, trusting networks?

WOUTER: If you have strong relationships, that is all good and well. But if you only have contact with the three good friends that you have, you may have sufficient social support, but it is very difficult to get ahead and get new information. This very close network shares information only within this network.

If you are talking about new health information or having a job opportunity, maybe you are in a different part of the neighborhood where 20 percent or more are without a job. How do you find a job if you only have connections within this small community? Those strong relationships are vitally important for the social support, and without the social support most people would be unhappy. But in order to get ahead, to get services, to get information, or to get a job, you also need those weak relationships with other people. Those are the acquaintances that you know, people who you can send an email to and ask if they know about a job opportunity. They are the people that you meet at parties or somewhere else.

Wouter Poortinga, Professor of Social Psychology at Cardiff University, is an environmental psychologist whose recent research has focused on the role of social cohesion and social capital in well-being and community resilience.

In the Mediterranean countries you often have families where there are links between different generations. If you have those links between different generations, you can learn more about different views of the world. When you only go out with people of the same age, gender, and political orientation, you have a very narrow view of the world. Also in terms of information, you are just concerned with what you think yourselves.

There is also the idea that if you only rely on those strong contacts or strong relationships with people who are similar to you, it may have a negative impact. For example, if the social norms within the group are negative in terms of health behaviors, it will have a negative impact on you. A good example here is the Mafia. That is a very cohesive kind of group. You can't say that the outcomes are really positive there.

BRADLEY: How can health practitioners and other decision makers use these insights to use social cohesion and trust as a strategy to improve health and well-being?

WOUTER: That is a notoriously difficult question to answer. You can't say that people should have more contacts; you need to provide the services or environments that are con-

ducive to social interaction. It could be something as simple as how you design buildings. Or providing walkways, cycle ways, or other spaces where people have the opportunity to go out and meet each other. Providing parks is always a good way of providing an environment that is conducive to physical activity but also to social interaction.

I think that a good local example is that a couple of years ago we set up a weekly five-kilometer run within the park. That has grown exponentially in the last couple of years, and each Saturday we have three-hundred-people-plus taking part in that. That has become a very central part of the community and the way to meet other people and to be active at the same time.

It can be as simple as an initiative like that to get people out and create a situation or opportunity to meet other people. I am not sure that you can organize that top-down. You cannot say, "I am going to put a community center here and then people will meet more often." It does not tend to work like that. It is more about creating the conditions and not about organizing contacts or relationships themselves.

“ You can't say that people should have more contacts; you need to provide the services or environments that are conducive to social interaction. ”

BRADLEY KREIT Research Manager, Health Horizons Program

Bradley builds on his background in anthropology and history by exploring how every day decisions affect our well-being.





Facilitating social connection becomes an institutional strategy for enhancing health outcomes and meeting consumer needs.

In response to the wave of bottom-up sharing efforts, large-scale institutions begin to view working with and designing for collaborative networks as critical to their success. Food companies redesign packaging, vending machines, and products to make food simple for consumers to share and exchange, while mobile networking technologies enable consumers to share fresh foods, such as basil, in supermarkets, turning grocery stores into places to build ad hoc social connection. This drive toward connection is mirrored in a variety of health institutions, including hospitals and doctors' offices, where shared medical appointments join online social networks as increasingly popular tools for helping patients navigate their health conditions more effectively and at a lower cost. As large-scale institutions formalize peer-to-peer sharing, people gravitate toward formal contexts as trustworthy places to interact and share, and also place trust in the businesses and institutions that enable them to participate in co-creating experiences and products.

What's driving this future?

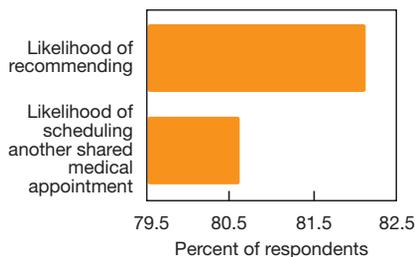
Advent of sharing as a business strategy

In recent years, companies, communities, and consumers have begun experimenting with sharing everything from cars to tools to clothing through local and increasingly national networks. As consumers embrace sharing as a low-cost strategy to get items they want and need, many companies will find they have few options but to capitalize on consumer networks and sharing. Over the next decade, these sharing networks will enable more people to gain access to basic necessities that produce health and well-being.

Rise of shared medical appointments

Between 2005 and 2010, the number of shared medical appointments doubled as health clinics from the Palo Alto Medical Foundation to Harvard Vanguard Medical Associates began experimenting with having patients share appointments as a way to provide better care while using fewer resources. As patients and health practitioners become comfortable with sharing health lessons and experiences in person, shared health encounters will become a critical strategy for improving health and well-being—particularly in areas with large disease and demographic burdens or in places with worker shortages.

Among Patients Who Experienced an SMA



Patients at Harvard Vanguard Medical Associates report strong satisfaction with shared medical appointments—while the practice reports expanded capacity to treat patients.

Shared Medical Appointments: A Novel Approach



Whole Foods has launched pilot wellness clubs where shoppers can learn nutrition and cooking skills from coaches and from each other.

Whole Foods to offer Wellness Club, articles.sfgate.com



Sharing is tracked, measured, and mandated as a means to navigate resource constraints and mitigate volatility.

In the face of environmental and economic constraints, sharing becomes a key strategy for maintaining physical health and emotional stability in a volatile world. This strategy aims at reducing waste of all kinds while at the same time maintaining basic health inputs through such tactics as renting empty front yards and rooftops to neighbors to grow food. Local communities harness the power of collaborative networks, engaging in time banking and other efforts to distribute caregiving responsibilities so that those in need can access emotional and physical support. In this context, sharing, trust, and collaboration become key metrics of the health and well-being of a community. These variables also become components of individual identity and online reputation, as trustworthiness and willingness to participate in broader social structures are seen as virtues and overindulgence becomes socially inappropriate.

What's driving this future?

Growth of social reputation scoring

As sharing services have gained traction, a number of observers have suggested that services that track and measure social reputation—much like a credit score—will be critical to facilitating sharing among strangers. In a world where sharing and collaboration are seen as essential to maintaining health and well-being, efforts to use reputation scoring and to closely measure how willing people are to participate and share will become critical to cultivating relationships.

Rise of well-being metrics

In the past few years, governments, think tanks, and research firms have all begun experimenting with ways to measure and track various indicators of well-being. As research establishes more firmly the well-being value of socially cohesive environments, cohesion will come to be seen as one of a handful of significant indicators—and this indicator will begin to shape personal and family decisions about such matters as where to live.



Trust Cloud is one of several start-ups aimed at scoring the trustworthiness of individuals to facilitate peer-to-peer exchange.

trustcloud.com



UC Berkeley's Resilience Capacities Index includes several measures focusing on social cohesion and engagement as markers of a region's resilience.

brr.berkeley.edu/rci/data/ranking



Networks become insular as sharing and trust decline in a world of increasing pressure and turbulence.

During a decade of economic challenges, trust in strangers drops precipitously. People all over the world become less willing to share and collaborate with their neighbors and others they don't know well. In parts of Asia, fights erupt over basic health resources such as water, while people everywhere increasingly regard each other with fear and suspicion—and hesitate to share or help. Participation in community organizations, collaborative caregiving efforts, and civic safety nets declines, leaving more and more families without access to healthy food, secure housing, and other basic inputs to health and well-being. The stress and anxiety that accompany not trusting one's neighbors exacerbate these conditions. Close friendships and family relationships remain critical to health, but even those get strained by mistrust, and people with small families or few close friends find themselves increasingly alienated, lonely, and sick.

What's driving this future?

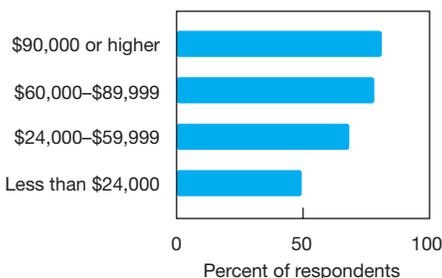
Long-term economic volatility

A recent Federal Reserve study found high correlations between economic difficulties such as unemployment and declining trust in a wide variety of institutions, while other surveys have found that people in lower income communities are far less likely to trust neighbors. The threat of a decade of economic challenges raises the real possibility that levels of trust will decline—causing people to be less willing to interact with strangers for health or other reasons.

Increased health risks from isolation

In a recent review of research into the health effects of loneliness, Louise Hawkey and John Cacioppo argued that social isolation stems from feelings that others pose significant threats to one's safety. Thus, fear tends to drive isolation, and this effect contributes to the negative health impacts of loneliness, including reduced immune system response. Direct health effects are compounded by reduced access to health and well-being inputs stemming from being less socially connected.

Trust in Neighbors by Income



Gallup asked more than 200,000 people whether they thought a neighbor would return a lost wallet and found differences by income.

In U.S. Trust Varies with Income, Education, Race, and Age, gallup.com

Comment Tweet 788

Airbnb Victim Speaks Again: Homeless, Scared And Angry



MICHAEL ARRINGTON

Friday, July 29th, 2011

Comments

Airbnb, a community marketplace where people can list and book guest space in homes, came under fire when renters trashed rented rooms.

Airbnb Victim Speaks Again, techcrunch.com



Sharing is a means to create new social connections—and rebalance well-being resources.

Over the next decade, sharing networks enable people to connect across geographic and other seemingly insurmountable boundaries to make meaningful contributions to each other's lives. These efforts are driven in part by technological innovation aimed at creating more empathetic views into the lives of others, such as simulations offering the opportunity to immerse oneself in experiences of aging, disease, and poverty. Other digital sharing efforts involve donating personal health data so it can be aggregated on a massive scale and turned into a source for collective health and well-being. With enhanced understandings of the lives and conditions of others, people increasingly look to donate and share surplus wealth and food. For example, many dieters pledge to donate the money they would otherwise spend on indulgences to hunger-related charities as a means to connect personal health goals with the needs of others.

What's driving this future?

Emerging empathetic technologies

In recent years, technology researchers and developers have begun experimenting with games and other simulation tools to help people imagine the experiences and challenges of others. Over the next decade, these emerging technologies will help design and engineering professionals rethink and improve physical spaces and environments to make it easier for people with physical challenges to exercise, access basic needs, and otherwise improve their health and well-being.

Aggregating microcontributions

Individuals have begun making small-scale microcontributions of things like data and work in an effort to join together with others and create new well-being capacities. In many instances, these microcontributions are aimed at turning previously distributed knowledge and assets into a broad, shared resource that people can use to understand and improve their health and well-being.



Developed by MIT, the AGNES (Age Gain Now Empathy System) suit enables people to experience the effects of aging so they can design more accessible spaces for older people.

agelab.mit.edu



San Ramon, California, has developed a smartphone app to notify trained citizen first responders of nearby cardiac arrest so they can provide CPR before paramedics arrive.

firedepartment.mobi

Insights: why trust matters

As the health benefits of a large network of trusted weak ties are further established, opportunities will emerge to facilitate interaction, trust, and connection.

o Persuasive design tools encourage sharing

While it may not be possible to make people trust each other, smartly designed spaces and well-planned events can significantly increase the likelihood that people will interact and build relationships and trust. Identifying opportunities to redesign everything from hospital waiting rooms to offices in order to encourage interaction will be key to enhancing trust and cohesion. Similarly, viewing retail settings such as supermarkets as opportunities for consumers to share and interact will create opportunities to engage consumers while enabling them to connect with each other.

o Safe spaces and processes limit the risks of participating

For many people, the idea of trusting, sharing, and collaborating with strangers will seem threatening and potentially risky—at least at first. Creating safe spaces and clear processes for people to interact will enable organizations to participate in building trust to enhance health and well-being.

o Crowdsourced solutions build collective capacities for well-being

Many of the most effective crowdsourced solutions, such as the San Ramon Fire Department's efforts to crowd-source emergency rescue, succeed by creating value that all participants can share. Over the next decade, some of the most successful efforts at co-creation will involve finding ways to effectively engage people and enable them to co-create experiences and initiatives that enhance individual as well as collective health and well-being.

o Shared experiences enhance understanding

Whether it's by offering shared medical appointments to enable patients to collectively understand their health or using experiential simulations to enhance product development and facility design, finding ways to create shared experiences and understandings will be central to building trust. These tools will help develop more cohesive community relationships and also encourage product and service innovation.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop trust-based initiatives in the coming decade.

Trust erodes

Trust in many institutions—particularly large institutions—has been on the decline in recent years, a factor that may make engaging in trust networks difficult for large organizations.

False barriers inhibit exchange

A variety of regulatory and other factors may make formalized sharing and exchange tricky.

Key resources

Botsman, R., and Rogers, R. *What's mine is yours: The rise of collaborative consumption*. New York: HarperBusiness, 2010.

Cacioppo, J. T., and Patrick, W. *Loneliness: Human nature and the need for social connection*. New York: W. W. Norton, 2008.

Gansky, L. *The mesh: Why the future of business is sharing*. New York: Penguin Group, 2010.

Shareable: Sharing by Design, <http://www.shareable.net>.



INSTITUTE FOR THE FUTURE

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why measurement matters

The rise of smart cities and citizen mapping efforts is making invisible aspects of the city visible. Tracking information from many sources—location reports from devices and vehicles, readings of tagged objects, status updates on social networks, and data captured by environmental sensors and cameras embedded in buildings and infrastructure—is giving us a higher-resolution understanding of how subtle elements of our environments shape our health risks, well-being capacities, and latent behavioral motivations. These transparent resource webs will create opportunities to optimize physical resources and develop anticipatory health measures that enable us to program automatic interventions triggered by sensory stimuli.

Focused at the **scale of environments**, this forecast perspective explores emerging responses to the question of **why measurement matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that measuring the health effects of our environments could reshape health and well-being.

Behavioral pattern mining

Improved understanding of latent motivations

Open-source software for picturing the spatial layout and movement of a city, along with improved visualization tools, will provide a more contextualized understanding of the everyday decisions people make. Embedded sensors in our homes, schools, and built environments will offer a more precise view of the activities of city residents. Our behavioral patterns will be easier to recognize, and this will help explain the motivations behind our actions. These understandings will drive interventions aimed at improving health by addressing once-hidden motivations. Simply sharing the findings derived from improved pattern mining, such as letting people know how long they remain sedentary, may motivate people to make changes.

Transparent resources

Enhanced tracking of health risks and assets

Aided by technological advances and an engaged public, tracking and monitoring of physical resources and health services necessary for improving well-being—clean water, nutritious food, safe spaces for exercise, access to health care providers—will become easier. In addition, new discoveries will reveal previously unrecognized capacities for well-being and open up more opportunities to optimize resources. For instance, the ability to broadcast a person's availability for a few hours of labor, an emergent carpooling opportunity, or an excess of fresh fruit and vegetables will transform surpluses of time and goods into shareable capital. This type of information will galvanize community support, enable people to find shared interests, match talents with needs, and create new exchanges for bartering and trading.

Diverse data streams

New insights from bridging personal and environmental data

Increasingly, our digital footprints will include information on such diverse topics as our mobility, social relationships, financial transactions, and genetics—and a variety of insights will emerge from aggregating these data streams and analyzing their relationships to data about our physical environments. Connecting these streams of information has the potential to reveal hotspots and locations, such as city blocks, that impact health in specific ways. At the same time, privacy concerns and other data security challenges may make it difficult to effectively link personal and environmental data streams.

—Rachel Maguire



expert voices MIT's SENSEable CITY LAB

RACHEL: So much of the experimentation in transparent resource webs tends to be generated from environmental, biometric, or mobility data. There seems to be a big disconnect between our traditional understanding of medical data collected in the clinical setting and all these initiatives around tracking your sleep, your exercise, what you eat, your stress level, and so on. Health InfoScape is one of the few projects where you've started with EMR data. What was the primary objective behind this project?

DOMINIK: We wanted to use data from electronic medical records and relate health to space—to cities—and to make health data somewhat accessible to the general public. What we are trying to achieve, on the one hand, is to do basic research to come up with new mathematical models that explain statistical irregularities of disease progression. On the other hand, we want to communicate this through visualization because it doesn't help if very complicated research and inaccessible data is only available to other researchers.

RACHEL: What data did you have access to?

DOMINIK: We had access to the complete stratification in the 114 million electronic medical records we looked at and the complete coding of the diseases.

RACHEL: What were some of the limitations of your data set?

ERIC: Most of our data begins in 2005 and ends in 2010, which makes it a short example of a longitudinal study. You can imagine 20 to 30 years down the road the statistical wealth that having standardized databases in health is going to create. This is just the first iteration, so once we start folding in other data sets from the census or geographic data, that will give us a much clearer, more refined picture of associations of health.

DOMINIK: From medical data you don't get social network data, so we want to enrich health data with something that tells us more about how people are connected. Next up is layering data on top of each other to tickle some interesting, novel results out of it.

RACHEL: Our forecast suggests that by mining the data, we'll be able to determine behavioral patterns related to health risks. What were some of the surprises you uncovered once you began to mine the data?

ERIC: There were obvious findings, such as Type 2 diabetes correlated with obesity and hypertension. A not-so-obvious finding was that tobacco use was correlated with both depression and insomnia. We're not saying they're causal relationships, but just to know that those things happen concurrently is interesting.

DOMINIK: And if you flip between genders while having tobacco use highlighted, you can see that, for example, insomnia is only really strongly correlated with tobacco use for females, not for males. So I think one aspect of the surprise is to see that diseases do not behave in the same way for males and females.

RACHEL: Our forecast also anticipates that transparency will uncover new risks and assets. How might health care providers benefit from visualizations like Health InfoScape?

DOMINIK: Medical care today is reactive—people go to doctors when something is wrong with them. With this kind of data set, we can move to a much more proactive medical care system by analyzing a person's medical history and predicting likely outcomes. And if there are statistically very likely future health outcomes, maybe the doctor needs to employ a monitoring scheme. This may mean addressing health concerns before they are an issue.

The SENSEable City Laboratory at MIT looks at unique data sets to reveal something about urban life. In August 2010, the lab partnered with General Electric to study electronic medical records (EMRs) to produce compelling visualizations that engage the public. SENSEable City researchers Dominik Dahlem and Eric Baczuk spoke about the first installment of that project, called Health InfoScape.

RACHEL: Finally, our forecast notes that transparent resource webs will generate a lot of data. What does Health InfoScape teach us about the value of data?

DOMINIK: Nobody wants to share sensitive data. It can very easily be abused. People worry that if insurance companies know the personal history of a person, they can design very personalized health care policies. This is in the interest of the insurer but not in the interest of society at large. So I think communicating what one can do with data like this may open the eyes of policy makers to provide legal frameworks to allow sharing data, anonymized potentially, for the greater good of society.

It is not easy to get access to this type of data and will not be easy in the future, but to address more ambitious goals, like creating a more proactive health care system that actually reduces the cost of health care, we'll need to have access to this large-scale data. We'll need to have collaborations that tie industries, government, and academic institutions together around a common good.

RACHEL: How do you anticipate people using Health InfoScape?

ERIC: First and foremost, the visualization is effective in helping people make some sense of an absolutely massive data set in an interactive way. I think another aspect of the visualization is that it allows people to explore the data on their own. If you introduce ten different people to this visualization, each of them is going to use it in a different way and focus on areas that are more interesting or relevant to them, based on family medical history or their own personal history.

RACHEL: What's next for Health InfoScape?

DOMINIK: In future work, we want to highlight what the health of New York looks like compared to Boston, or compared to a rural town in Arizona. Of course, medical practitioners know this information, but we feel that it's important to communicate that to the public with a relatively simple visualization. This will point the way to understanding how disease is related to geography—to cities—and open this up to feedback from the general public, outside the silos of the private industries and the academic institutions.

“ ... visualization is effective in helping people make some sense of an absolutely massive data set in an interactive way ... it allows people to explore the data on their own. ”

RACHEL MAGUIRE Research Director, Health Horizons Program

Rachel applies trends in new media and mobile technologies to her health systems expertise to study how personal technologies are informing health care practices.





Transparent resource
webs enhance efficiency
to promote day-to-day
well-being.

In a world focused on growth, smart, connected sensor technologies have unleashed a wave of commercial and civic experiments to harness data to enhance efficiency and experiential well-being. Smart sensor nodes anticipate and manage traffic flows, and communicate the information directly to commuters. Buses and smaller vans that operate like group taxis are rerouted for efficiency—reducing the stress and risks of driving, and giving sedentary people more time to exercise and take care of their health needs. As consumers increasingly find themselves overwhelmed by abundant data, they gravitate toward products that offer proven results. This results-driven mentality favors immediacy, making health interventions with downstream payoffs harder to promote. The deluge of new information results in increased stress and anxiety, contributing to a decrease in overall feelings of well-being.

What's driving this future?

Upsurge in smart feedback for smart living

The massive upsurge in sensor technologies embedded in environments, homes, cars, and even our bodies is creating the infrastructure to track mobility patterns and anticipate potential health-risk hotspots. The ubiquity of mobile communication devices is enabling people to receive relevant, timely, location-based information, with options for them to more effectively navigate their environments.

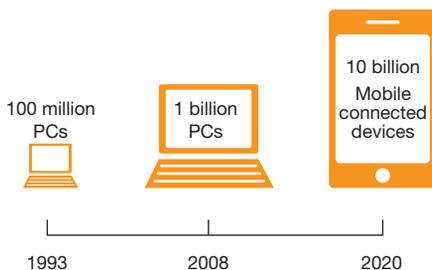
Boom in data collection and analytics

Seeing the growing demand for more sensory, real-time, location-based data, technology companies are homing in on urban consumers, marketing a wide array of services, many of which promise to improve a user's health and well-being. While many consumers will be intrigued by these new offerings, companies will struggle to avoid overloading consumers with information and choices.

Growing demand for demonstrated value

Enhanced measurement will enable data analysts and health practitioners to verify the efficacy of a variety of medical and nonmedical interventions. More complex care strategies with effects that are harder to measure or take longer to materialize will get pushed aside in favor of simpler interventions with benefits that are easy to prove.

Devices in Use



According to an Economist special report on personal technology, there will be 10 billion mobile connected devices by 2020.

economist.com/node/21531109



LIVE Singapore!, an open platform designed by the MIT SENSEable City Lab, collects data from diverse sources to generate visualizations that can help optimize personal and city resources.

LIVE Singapore!, MIT SENSEable City Lab



Tracking behaviors and patterns results in new limits and new stresses.

In a world of constrained resources, transparent resource webs become a tool for governments and a source of peer pressure, imposing limits on how we create well-being. With a virtual tag cloud following individuals as we move about in our daily lives, consumption footprints are neither opaque nor private. Behaviors such as how much energy we use, how much food we consume, and how much community service we contribute are tracked and made public. This tracking is often used to regulate where we can go and what we can consume, and at times serves as the basis for fees imposed for excess consumption. While these constraints help ensure that people have sufficient resources, the stress of accepting new limits harms mental and emotional health, leading to other long-term health challenges.

What's driving this future?

Intensifying resource constraints

A cash-strapped public sector and looming changes to Medicaid, other entitlement programs, and social services promise to reduce the scope of future health and well-being services provided and financed through the government. Unlimited provision of services such as tap water, electricity, and trash collection will come at a much higher price. As these constraints emerge and intensify, learning to accept and live within a world of vastly stricter resource limits will cause emotional and physical health challenges.

Proliferation of smart, connected technologies

An expanding selection of smart, lightweight tracking devices and mobile applications is making tracking an increasingly passive and automated practice. Whether sensors are embedded in or on individuals and vehicles, in workplaces and schools, or in the city's built environment, the ability to track and quantify consumption and other behaviors associated with daily living is becoming more available. In its extreme form, tracking will enable governments and communities to impose and enforce strict limits on everyday behavior.



GreenWave Reality offers a home energy management platform that helps consumers conserve energy by monitoring and controlling their appliances, lighting, and high-load devices.

greenwavereality.com



NextDrop provides households in Asian cities where piped water is available for only a few hours a day with timely and accurate information via cell phone about daily water delivery.

nextdrop.org



Transparent resource webs
reveal health inequalities
and create resource
hoarding.

More data has only confirmed long-held suspicions about inequity and maldistribution of resources. For example, visualizations make it easier to see that underserved city neighborhoods with high populations of children where pediatricians are scarce are also frequently the neighborhoods where environmental health risks are most prevalent. With more quantifiable evidence demonstrating that the conditions needed to create good health outcomes are not equally distributed throughout cities, resentment grows between neighborhoods. Resource-rich communities become far more aware of their resources—and build closed systems to protect what they have. These opaque resource marketplaces make any formal systems of tracking and collecting data incapable of accurately depicting consumption patterns and unable to anticipate shortages or surpluses, creating further distribution inequalities.

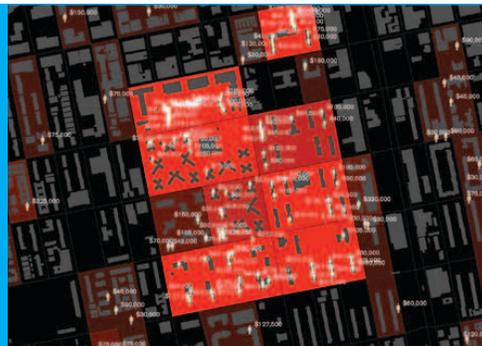
What's driving this future?

Experiments in mapping neighborhood inequities

Early experimentation in using data to show varying resource allocation in different neighborhoods has demonstrated the power of quantifiable evidence to depict inequity. In 2005, The Opportunity Agenda launched their “healthcarethatworks” project, focused on mapping hospital closures in New York City. Layering data on top of Google maps, their mashups showed that New Yorkers who live in predominantly minority communities face greater geographic barriers to accessing a hospital than those who live in predominantly white communities. As these kinds of inequalities become more transparent, hoarding and intercommunity resentment will grow.

Experiencing the consequences of health care disparities

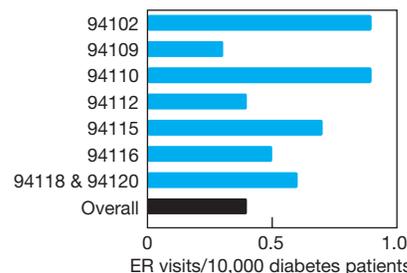
More information has bolstered a higher degree of awareness of the devastating effects that unequal access to health care resources has on underserved populations in cities. In a world of strained resources, those who have resources will hoard them—further exacerbating health outcomes among the less fortunate.



Columbia's Spatial Information Design Lab and the Justice Mapping Center visualizes city blocks where disproportionate spending goes toward prisons rather than health services.

Million Dollar Blocks, Columbia

Hospitalizations by Zip Code



In San Francisco, Community Vital Signs highlights differences in health status, outcomes, and access to care, with tools such as this chart of hospitalizations due to uncontrolled diabetes.

Community Vital Signs, Health Matters in San Francisco



Transparent resource webs power participatory systems to build capacities for well-being.

Knowing more, it turns out, has resulted in doing better. Knowing that an elderly neighbor is hoping to go to the same grocery store as you at the same time enables you to conveniently lend a hand. Knowing that someone in your network needs social support allows you to make a quick phone call to her. The availability of real-time knowledge of states and behaviors is also driving larger-scale efforts to improve well-being. Flourishing cities are using rigorous scientific analysis to identify pivotal adaptations and to support people, businesses, and schools in changing behaviors at all levels. Initiatives are generated by extracting the best practices from behavioral economics and choice architecture, and adapting these to reflect what is politically feasible in the local environment. These are creating urban environments that reward incremental changes by many to produce substantive improvement for all.

What's driving this future?

Broad civic experimentation

Bottom-up, participatory initiatives are under way in cities across the globe. While efficiency generally isn't an outcome that emerges from open, crowdsourced initiatives, successful solutions are being shared more broadly. Best practices are being communicated through open platforms, allowing individuals to learn about the basic premise of a successful project and then customize it to make it work in their cities.

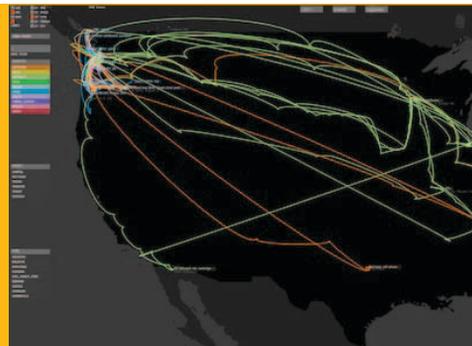
New realizations about sustaining urban vitality

Revamping, retrofitting, and redesigning physical structures in the city so that they are greener and healthier can only go so far toward ensuring long-term urban vitality. There is a growing realization that individual and community well-being is derived from a broad range of social determinants, and that investing in high-quality education, health promotion, and creative work opportunities is essential to sustaining a vibrant ecosystem of well-being.



The Independent Transportation Network consists of volunteer drivers who use their personal vehicles to provide rides to seniors, accumulating credits in personal transportation accounts to be used later as currency.

itnamerica.org



In Seattle, city officials used MIT's SENSEable City Laboratory's project Trash Track and attached electronic tags to show how trash moves in an effort to change behavior around waste.

Trash Track, MIT SENSEable City Lab

signals

Insights: why measurement matters

Having high-resolution views of the places we live—and of how granular details impact our health and well-being—is creating new opportunities for developing targeted health interventions and for building place-based well-being capacities.

o Transparency reveals barriers to action

It's easy to jump to the conclusion that once we know more about the health risks and resources around us, we'll make better decisions. In certain cases, this may be the outcome. But in the short term, the changes needed may be too large for individuals or individual communities to create. A higher level of transparency may uncover additional inequities and barriers to good health so they can be addressed.

o Trust facilitates data sharing and transparency

For transparent resource webs to produce useful and accurate readings of the pulse of an urban environment, people will need to believe that the sensitive data they share will be protected. In addition to investments in infrastructure that assures secure central (or cloud-based) databases, reputation services will be absolutely critical to self-organized ad-hoc knowledge and information sharing services.

o Data collection outpaces analytic capabilities

The new kinds of information collected through personal mobile technologies, tagged objects, status updates on social networks, and lightweight sensors will demand new theoretical models to make sense of it all, but development of these models will lag behind. A diverse set of actors—academics, policymakers, private organizations, hackers—will derive important insights from parsing the data but aggregating these insights into comprehensive tools to facilitate action will be more difficult. Individuals, networks, and communities will struggle to connect the dots between their own behavior patterns (which will be increasingly visible to them) and the potential for increasing the well-being of their cities.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop measurement-based initiatives in the coming decade.

Standards for action will be uncertain

Passive sensing and streaming of data about real-world activity will spur new approaches to designing studies and new forms of data collection. This data will create not only new insights but also new kinds of questions about standards for acting on this information.

Gaps will open up between knowledge and response

While new data streams will point to hidden health disparities and opportunities to address them, communities will often bear the responsibility of determining how best to leverage those opportunities.

Key resources

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why **place** matters

The built, natural, information, and social environments all impact our well-being. Health risks such as the effects of poor air quality and the stress of living in a high-crime, high-poverty neighborhood are intimately tied to place, as are health benefits such as a positive environment's ability to influence us to make healthier choices around diet and exercise. In this sense, the health impacts of place are shared by local communities and citizens. Over the next decade, as these shared risks and benefits become clear, bottom-up, experimental efforts that leverage the connection between place and well-being will focus on reimagining spaces, boundaries, and even the narrative identities of places in order to enhance collective local health and well-being.

Focused at the **scale of environments**, this forecast perspective explores emerging responses to the question of **why place matters** to health and well-being in the coming decade. Inside, you'll find four alternative scenarios that highlight four distinct, plausible ways that measuring the health effects of our environments could reshape health and well-being.

Optimizing spaces

Growth of well-being communities

The importance of place is driving a variety of efforts to optimize local spaces to enhance health and well-being. Already, communities have begun organizing to eliminate risks like food deserts and air pollution, and these efforts are moving toward building broader well-being capacities. New inquiries into the health effects of built environments are paving the way for design innovations aimed at impacting our bodies directly. Projects such as Seoul's recent uncovering of a paved-over stream—which has reduced air pollution by a third, cooled the local environment by five degrees, and increased biodiversity while providing exercise and social connection for its 90,000 pedestrian visitors per day—demonstrate urban design's potential for holistic change.

Shaping boundaries

Creating flexible definitions of local

Lightweight technologies are giving us tools to create bottom-up maps and definitions of health risks and benefits independent of traditional political boundaries. Take, for example, Water Canary, an inexpensive water-testing device that gives ordinary people real-time access to water-quality data. Tools such as this, along with citizen mapping projects, will allow people to identify risks such as air and water pollution as well as resources such as urban parks to flexibly define boundaries based on where risks and benefits begin and end.

Rewriting narratives

Co-creating the health story of place

Consciously defining the character of the places where we live is becoming a new frontier for improving biological health. By linking community identity to a healthy lifestyle, places can inspire collective well-being efforts. For example, the City of Albert Lea, Minnesota, participated in a year-long project to reorient around health and well-being through a set of local initiatives that included encouraging restaurants to offer healthier menu items and creating a "walking school bus" for local children. At the end of the Vitality Project, residents surveyed had a life-expectancy increase of almost three years. These sorts of cocreated narratives will increasingly define place—and become central tools to collectively build health capacities.

—Ben Hamamoto



expert voices **JEREMY LIU**

BEN: Tell us a bit about some of the strategies that local communities are using to enhance the health and well-being of their residents.

JEREMY: Localism has been used for years in the local currency movement and is certainly one of the core concepts of the Slow Food and now even Slow Money movements. In a different way, the Village to Village Network of aging-in-place programs is all about localism. Even a public financing mechanism like tax increment financing (TIF) is a form of localism. Place-based charter schools, credit unions, even community colleges are all built on the idea of localism in some way.

All the social epidemiology work points to localism as well. Research coming out of schools of public health says that if someone tells you where they were born, social epidemiologists can predict with great certainty what the health outcomes of that person will be.

Local hiring is also being used to create well-being. The Oakland Housing Authority has a Section 3 regulation that allows them to try to proactively hire from among their residents. So they can source locally, and by locally they mean anyone living in Oakland Housing Authority units. If you spend your money locally, you have a greater recycling impact; the money gets amplified.

BEN: We're talking about economic development. How does that relate to physical health?

JEREMY: The stress caused by financial issues has a direct impact on health, but also the fact that you might not have enough financial resources to take care of specific health issues is an obvious direct impact. I was just reading about the scarring effect of unemployment. Unemployed people report substantially lower well-being scores over what might be expected from the loss of income. It has a scarring effect by which a life-satisfaction deficit remains even after people have become employed.

BEN: How do you think technology might help us better understand the relationships between place and health?

JEREMY: I think the intersection of social epidemiology and technology is going to enable greater perceivability of the things that affect our health. The traditional measures of health have been empirically defined. Either you have TB or you don't. Now, it's: "Is that noise keeping me up at night and causing my child to not do as well at school because he's tired?" Just like the microscope was the tool that allowed us to see bacteria in blood, I think the tools that we're developing now are going to let us see and map social indicators better.

This will enhance the submunicipal level as an intervention point, definitely. More and more technology will give people agency at the local level because data information sharing and relationship building will be facilitated by technological changes. Oakland Crime Spotting, a site that takes user reports of crime in the city and maps it, has opened up a level of awareness about crime in neighborhoods that has never been possible before.

I've been trying to create a 711 system for block watch groups. Until now, the highest form of technology used by neighborhood block watches has been the phone tree on the refrigerator, or maybe an email listserv; neither of those things allow us to tap into their safety-in-numbers idea effectively. So I think there is room for a system where, if you dial 711 from your cell phone and leave a message saying, "Hey, I see someone trying to open up cars on our block. Everybody turn on your lights and come out to the porch," it will go out to everyone on your block watch who is at home at that moment.

Jeremy Liu is the executive director of **East Bay Asian Local Development Corporation (EBALDC)**, a community development corporation that integrates housing, community services, and community development in the San Francisco Bay Area. His recent work focuses on using housing development to expand the health and well-being capacities of low-income communities.

BEN: Describe some of the work EBALDC is doing around place and health.

JEREMY: We are taking a focused approach to our community development work, deepening our attention to specific neighborhoods. We're using localism as a step up from project-by-project real estate development of affordable housing and community facilities, which means focusing our attention on improving the neighborhood surrounding our projects. Specifically, we have been using the social determinants of health developed by social epidemiologists as the framework for our localism strategy.

We are also planning our own pilot projects such as Cohort Housing. Cohort Housing is based on the premise that strong bonds and communities already exist in various forms—including extended families and friendships—and that they can be leveraged by offering bundled “extended family” Section 8 voucher programs to renters and creating mechanisms to allow for group sales of homes in certain neighborhoods.

BEN: So do you see fostering a sense of community or regional self-esteem as an effective health intervention?

JEREMY: It's a little different than regional self-esteem, but there is something we call neighborhood narratives that tell the story of a locality. Stories of place get created collectively by lots of different actors, and they act out both their disrespect and respect for place. I think there's some aspect of regional self-esteem that comes out of that. The work we do is about trying to change the story.

In West Oakland there's a corner where drug dealers hang out right next to one of our properties. We've talked internally about how to change this space to make a new dominant narrative. We held a job fair and the drug dealers all came, but we couldn't offer anything concrete enough. They all came up to us and said, “We really appreciate this.” These guys have been there long before any of us; that's part of the narrative of that space. And until we can change the story of that corner from being somewhere you can go and hang out and pick up a little illegal work on the side to being the place where you come and hang out and EBALDC is going to find you a job, that's not going to change.

“ The traditional measures of health have been empirically defined. Either you have TB or you don't. Now, it's: 'Is that noise keeping me up at night and causing my child to not do as well at school because he's tired?' ”

BEN HAMAMOTO Research Manager, Health Horizons Program

Ben uses insights from his background in journalism covering issues of race and inequality to explore how well-being is shaped by social and environmental contexts.





Healthy places emerge from economic activity, and market offerings provide solutions to place-based risks.

In a growth scenario, economic development efforts as well as market-based offerings aim to improve health-related aspects of place as parts of larger growth-based initiatives. Large-scale, top-down infrastructure projects such as car-free development and retrofits of public spaces, along with regulations such as fast food moratoriums, characterize the public sector's approach to health, while some bold, resource-rich governments experiment with everything from horizontal farms to carbon-negative man-made islands. The private sector offers environments optimized for well-being to meet consumers' health anxieties and aspirations, as well as goods and services for homes and offices, including such elaborate offerings as microbiome-releasing devices and living walls made of plants to enhance psychological and physical health. These government and market offerings are a major marketing tool for real estate agents looking to sell homes and companies looking to attract talent.

What's driving this future?

Growing recognition of ways to enhance health through place

Organizations have already begun experimenting with community-based initiatives and small-scale local interventions to manage health risks. For example, local governments and community groups in Detroit have begun focusing on eliminating food deserts, and Kaiser Permanente now hosts weekly farmers' markets on many of its properties. As the links between place and health become increasingly clear, health insurers and providers may find it makes financial sense to build community health.

Improved place-based health measures

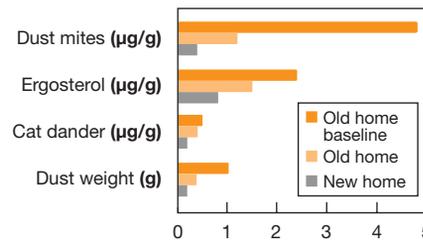
In the next decade, technology will aid the development of increasingly granular environmental health measures. Already, this kind of mapping has led to new metrics that quantify the health value of certain places, such as Walk Score, an index that assigns any given address a walkability score based on the distance to various amenities. As these kinds of measures proliferate, they will reshape our understandings of place and health.



The Walk Score site not only offers assessments of an area's walkability but also lets users search for hotels and apartments based on their walkability score.

walkscore.com

Environmental Housedust



Seattle and King County have made the construction of asthma-friendly Breathe-Easy Homes for low-income families part of a larger health strategy to revitalize the High Point neighborhood.

Breathe Easy Homes, Public Health Dept., Seattle and King County



Participatory local efforts restrict behaviors in order to maintain basic levels of community health.

In a world where resources are scarce, communities limit local behavior that hurts collective health, just as homeowner associations restrict the way individual homeowners can use their property. Communities embed cheap, lightweight sensors in environments to enforce health regulations and local agreements that reflect community values. Some locales focus on resource conservation, setting quotas for everything from water usage to food waste. Others more strictly enforce existing noise restrictions. Some communities place limits on nonemergency car use to cut down on auto traffic, which contributes to pollution and hurts social cohesion, and some impose heavy fees for entering and exiting the area as a way to keep money in the local economy. Sensors aside, almost all community institutions impose health-based local restrictions on everything from building materials to the food served in schools and restaurants.

What's driving this future?

Explosion of embeddable sensor technology

Already, traffic signal cameras are enabling place-based embedded governance. In a decade, these kinds of sensors and technologies—capable of monitoring and recording everything from the movement of people and vehicles to air quality, sound, even bacteria in the air—will be ubiquitous, enabling location-based governance of a variety of facets of our local environments. Privacy concerns will make their use contentious, and implementation will therefore vary from place to place.

Advent of participatory monitoring

Sensors will also be available in consumer mobile computing devices, giving everyday citizens the ability to work together to police their environments. In some cases, these citizen-led efforts may be aimed at enforcing or creating restrictions that directly contradict the official rules in local communities. In other instances, these participatory efforts will augment government efforts to enforce place-based restrictions.



To improve parking in San Francisco, SFpark sensors track when and where city-managed parking is available and make this information available by phone and text.

sfpark.org/how-it-works



A study in San Marcos, California, showed that displaying above-average energy consumption on door hangers with a sad face indicating disapproval reduced average energy consumption.

Community-based Social Marketing: Using Social Norms to Reduce Household Energy Consumption



Visible local health risks
outpace communities’
ability to respond—and trap
people in areas of high
health risk.

New technology reveals an astonishingly high level of health risk—posed by factors from radiation to air pollution to built environments that encourage unhealthy lifestyles—in locations around the globe where the focus has been on short-term economic growth and where responsibility for environmental stewardship has not been clearly assigned. Most urban environments turn out to be “red zones,” areas of extreme risk, in contrast to “blue zones,” areas with high well-being capacity. With few truly healthy places to flee to, limited capacity to improve environments, and limited mobility, people with few resources view this new evidence as a catalyst for resignation instead of a call to action. Huge numbers of people find themselves condemned to live in harmful environments, wealth consolidates in small geographic pockets, and some desperate people relocate to less-healthy environments for work or a cheaper cost of living.

What’s driving this future?

Economic hardship fueling a regulatory race to the bottom

Localities have been competing to lower environmental standards so they can attract manufacturing jobs. Similarly, many communities have cut business and corporate taxes to attract jobs, and in the process, have had to reduce funding for public works projects—and the health effects of this reduced spending are accumulating over time. In the face of economic difficulty, communities will increasingly find themselves sacrificing health to ensure stability.

Multiple governance structures leading to shifting blame

Water, air quality, and other factors that affect community health are often regulated by several entities. In a decade of financial challenges, these entities will look to shift practical and budgetary responsibilities for regulation to each other, ultimately undermining basic regulatory structures. Absent clear lines of government responsibility, the burden of maintaining a healthy environment will shift to individuals and their consumption choices.



Photo: Flickr user denverjeffrey

A 2008 study found that risks such as lack of social support, pollution, and stress aggregate in poor neighborhoods, lowering quality of life and life expectancy.

Alameda County Public Health Department: Pioneering Equity in Public Health Practice



Photo: Flickr user Carla Vasquez

Journalist Michael Lewis popularized the term “service-level insolvency” to describe communities that can no longer afford to maintain community services.

California and Bust, *Vanity Fair*



Links between community health and community identity emerge, and collectively reinventing the narrative of a place becomes a strategy for enhancing well-being.

Over the next decade, citizens begin overlaying new narratives of place on top of traditional place names and stories. Communities co-create new stories of the health potential of a place and define public health spaces—for instance, flagging a park as a great place to go on a long walk with a friend, identifying arable public land, integrating backyard gardens into the local food web—in order to enhance individual health. Some of these narratives are stories of health risk and vulnerability, but co-creating these stories builds a sense of shared purpose and creates a means for advocacy. Geotagging—adding geographical identification metadata to various media—enables broadcasting of these location-based stories so others can search for, learn from, and further build these narratives of place.

What's driving this future?

Acknowledgment of paradigms as a leverage point

Attempts to use narratives as a health intervention are grounded in a paper by Donella Meadows entitled “Leverage Points: Places to Intervene in a System,” which identifies changing paradigms, or collective narratives, as the most effective of twelve different forms of intervention in a system. As the popularity of narrative approaches grows, they will combine with research linking individual and community identity to health and will drive a variety of efforts to enhance health by improving the community narrative.

Rise of participatory geotagging

The ability to use mobile phones to tag and share information in physical spaces will open up opportunities to tell new stories about place. For example, Christian Nold’s emotion map of San Francisco provides a high-resolution view of how the emotions of an observer shift by neighborhood. In the next decade, mobile tools will enable collectives to construct these kinds of depictions of place—and use these new understandings to create new local narratives.

Tohono O’odham Community Action is a community-based organization that aims to use narrative-based strategies around tradition, culture, and place as part of an overall local health strategy.

toaonline.org/Home.html



Tagwhat is an augmented-reality app that allows users to view and embed stories in the world around them and to filter based on interests.

tagwhat.com

Photo: Flickr User Cheryl Francisco

Insights: why place matters

Over the next decade, understandings of the relationships between the physical and qualitative aspects of place and health will lead to new kinds of interventions focused on local environments.

o **New metrics emerge to quantify the health impacts of place**

Though there are various measures of air quality and even neighborhood walkability, few tools exist for quantifying the health impacts of more abstract qualities such as the aesthetics of a neighborhood. This deficit presents opportunities to develop more robust measures that can be used to guide place-based interventions.

o **Community development and public health converge**

Demand for place-based health solutions will greatly expand the range of actors engaged in producing health and well-being. Communities have already partnered with zoning boards to use land-use policy to limit the number and density of fast food outlets and support the establishment of walkable streets, farmers' markets, community gardens, and full-service supermarkets. In the next decade, local community development organizations will increasingly work with health systems and other, more traditional stakeholders to enhance health and well-being.

o **Communities form to co-create narratives of space**

Correctly identifying the geography of an affected population is key for an environment-level intervention; it leads to recruiting the right stakeholders, thus ensuring that engagement is neither too diffuse nor too narrow, and it presents an opportunity to create a new community around health. By agreeing on shared health interests, a community can begin to define its own ideas of health and choose appropriate interventions, be it banning soda, restricting auto traffic, or planting trees. These bottom-up interventions will create new health-based identities for communities and effectively rewrite the narratives of their physical spaces.

Key tensions

These key tensions highlight potential conflicts and challenges to efforts to develop place-based initiatives in the coming decade.

Verification poses challenges

The inherent difficulty of scientifically verifying and quantifying the results of place-based interventions will lead to questions and concerns about how to act on relatively limited information.

Unclear lines of responsibility prevent action

Even when relationships between place and health are clear, who bears responsibility for improving a place is often not clear. Similarly, many local decisions require consensus among a variety of stakeholders. The combination of factors frequently creates hidden barriers to action.

Key resources

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