Wellth Creation: Using Computer Science to Support Proactive Health

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By moving beyond logical data collection and engaging people on a subconscious and emotional level, computing technology could change cultural norms and thereby more effectively motivate lifestyle changes that prevent disease.

The computer has become the generic tool in offices and homes around the world—nearly no desk is without one. However, the way workspaces are currently designed, with the computer on a table and the user sitting alone before it, has strongly contributed to the modern sedentary culture. As more work processes get digitalized, there's even less need to get up—to get a document or book, pick up a fax, walk to the printer, and so on. This is certainly not healthy. However, the emergence of many new information and communication technologies, from ubiquitous displays to tablet computers to wearable devices, provides us with a chance to fundamentally redesign ICT to move away from sedentarism—a leading goal of proactive health.

—Albrecht Schmidt, column editor

Computer science has been an integral part of healthcare for decades. Networking and communications technologies support telemedicine, bringing expertise to remote locations to aid in surgery, physical rehabilitation, and home care. Advanced graphics applications enable brain and body imaging. Data analytics and information visualization foster new understandings about relationships in medical records—for instance, between drug interactions and patient attributes.[1] Human–computer interaction has made the operating theater[2] and emergency room safer[3] and medical devices easier to use and more precise.[4] It's fair to say that innovations driven by CS help more people receive better healthcare, recover faster, and return home sooner.

Thus far, CS has had less impact on proactive health, or what we call "wellth"—that is, practices that lessen the chances of illness and improve overall physical and mental performance. Given the alarming rise in obesity, type 2 diabetes, cardiovascular disease, and other preventable conditions, we believe that using computing technology to support individual aspirations for greater well-being is just as important to society as using it to improve ways to cure disease.

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IS THERE AN APP FOR THAT?

When it comes to proactive health, the majority of interactive technology developers and researchers have focused on developing apps that are very good at doing what computers do best: counting. Apps connected to increasingly cheaper and sophisticated sensors tell us how much we weigh, how fast our hearts beat, how much we sleep, the number of steps we take. Other apps count the ingredients in our food: grams of protein and carbohydrates, vitamin content, number of calories.

These apps generally return raw data to the user in the form of, say, a histogram of steps, a line graph of weight, an average heart rate, a comparison of today's and yesterday's calories. But what problem are these counts actually solving?

There's a popular assertion—and a growing belief among app developers—that through this data people will learn more about themselves and somehow get healthier, perhaps simply by doing more of a good thing. But more isn't always better.

Many readers are likely familiar with "workplace challenges" designed to promote exercise—for instance, to increase steps each week using a step-tracking app or wearable device. After a while, as you grind out thousands of steps each day to meet the next threshold, the experience becomes dull and repetitive—you feel as if you're chained to the sensor. But what are enough steps? What does a massive step count accomplish? Nothing, actually. Research suggests that 7,000–9,000 steps per day is sufficient for disease mitigation.[5]

Similar critiques have been raised about calorie counting. It's easy for an app to match a food source to a database with nutrition information and, of course, calories, but weight loss isn't all about reducing calories. Many people regain weight after dieting, and this yo-yo effect often isn't due to lack of willpower: rather, it's attributable to insufficient nutritional knowledge—something a calorie-counter approach doesn't take into account.

BEYOND BEHAVIOR CHANGE

Despite their popularity, existing proactive health apps are only reaching for low-hanging fruit. ICT tools are needed that go beyond logical data collection to engage people on a subconscious and emotional level.

A recent pilot study we conducted revealed that most runners and cyclists use heart rate monitor watches to motivate completion of the activity, not to monitor their real-time performance. Simply having an HR watch, it seems, can trigger our desire to align practice ("go for a run") with how we perceive ourselves and want to be perceived by others ("look fit").

But what about those who don't run or cycle? How can we reach these individuals? Even without the data generated by heart monitors and other self-tracking devices, ICT systems can draw on other kinds of information to create wellth.

Computing devices can access a plethora of user data from social media, Web activity, calendars, GPS logs, and the like as well as associated contextual information—for example, about current news, weather, and traffic conditions. Integrating this personal and contextual data with machine learning for sense making in the proactive health domain remains, surprisingly, a blue sky ambition—and an obvious deep seam for researchers to explore.

Various APIs enable apps to copy data from one another—for example, a running app can display your weight results from a Wi-Fi–connected scale in the same screen. You can also patch a feed from one app into another to carry out certain actions: "If my weight exceeds *X*, send text message to friend indicating I owe him 20 quid." However, such simplistic approaches aim to induce behavior change without providing any context.

It would be more useful to combine relevant personal data with related contextual information to support informed decision making—that is, to make better normal and normal better. For example, suppose a system could analyze a user's calendar events and sleep data over a month and tell her upon waking one morning, "Honey, you really do need to slot in some rest; you're burning the candle at both ends. Look, you have two hours without meetings today and it's not going to rain: why not go for one of your favorite walks around campus?"

Such a wayfinding approach goes beyond trying to modify our behavior by presenting us with simplistic numerical targets; rather, it illuminates paths to wellness that we're more than happy to take but may not see on our own.

IT'S ABOUT THE SYSTEM, NOT ANOTHER APP

While behavior change certainly has a role to play in well-being, focusing on the individual ignores the environment and ethos in which individuals operate. As a systems science that examines complex operations, interactions, and infrastructure, CS could be leveraged to explore metalevel questions about proactive health. How can we use technology to support a new cultural norm that values achieving and sustaining well-being?

If the goal of proactive health is to change the status quo, to make better normal, that means eliminating sedentarism, a leading cause of cardiovascular disease strongly linked to overweightness and obesity as well as poor cognitive function.[6] Given that a person spends on average 9.3 hours per day seated, most of that at work and uninterrupted, how can we use CS to promote a more active lifestyle? A conventional approach would be to

employ "persuasive technology" to, say, set off an alarm every 20 minutes to remind someone to move. Can we do better?

To impact the problem at scale, we must consider the infrastructure that supports the cultural norm of sedentarism.

For example, if one solution is more "walking meetings"[7] outdoors, what kinds of tools would robustly support mobile idea generation? Could we create ruggedized digital white boards in the wild? Can we develop a system that captures sketches on the go in nanopaints on building exteriors and transmits them to the appropriate parties for revision?

Similar questions can be raised about changing other cultural norms. If eating more locally grown vegetables is beneficial, how can we use CS to make food production more local and sustainable? Is there a role for hydroponics and indoor Internet of Things–connected lighting in the built environment? Do we need new ways to deliver the knowledge and skills required to care for microclimates and microenvironments?

GRAND CHALLENGES FOR ICT IN PROACTIVE HEALTH

At a recent Dagstuhl Perspectives Workshop, "Exploring Interdisciplinary Grand Challenges for ICT Design to Support Proactive Health and Wellbeing" (www.dagstuhl.de/de/programm/kalender/semhp/?semnr=14272), participants discussed potential proactive health systems and techniques as well as the meta-level implications of design choices. If taken to their logical conclusion, what type of culture would such technologies foster? Does that align with goals like high quality of life and democratic liberty?

The workshop also considered frameworks for building out and evaluating designs. The consensus was that designs should evolve from unconscious to conscious and from logical to emotional engagement.

Attendants included experts in medicine, psychology, sports science, and sociology as well as CS, highlighting the multidisciplinary aspect of proactive health.

As a new and complementary paradigm to healthcare, proactive health opens up exciting system design opportunities and challenges. Properly harnessed, computing technology could have as great an impact on motivating lifestyle changes that prevent disease as it has had on existing medical practices to care for those who are already sick. To be successful, however, researchers must carefully consider novel epistemological and methodological requirements.

This year's Dagstuhl workshop was a first attempt to broadly engage the CS community as well as experts in other fields to make the world healthier by changing cultural norms. We look forward to continue working toward this goal.

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