Mental Healthcare at our Fingertips

The Mental Healthcare Crisis

When I was still relatively young, my mother lost control of her car when it hit a patch of ice two days before Christmas. Her car spun off the road, her seat collapsed, and she experienced a traumatic brain injury. She survived but she never recovered even to the

point of recognizing my sister and me again. She required full-time care for the rest of her life.

My dad is a good man. He devotedly stayed home for 25 years rather than work so that he could care for my mom at home rather than commit her to an institution.

My dad is a good man who he has struggled with his use of alcohol for his entire adult life. At times, it was in the background of our lives. At other times, it was quite severe. He is almost 80 years old now and he has never received any treatment.

It breaks my heart, but it is not surprising. And I expect that many of you have similar stories about family and friends who didn't receive the treatment they needed.

We have a mental health crisis in the U.S. and it is a crisis of **unmet** high need because our delivery of mental healthcare is deeply flawed.

In 2019, more than half of the 52 million Americans with an active mental illness did not receive **any** treatment. **More than half**!

And for those suffering with a substance use disorder - like my dad - it was worse still. **9 out of 10 without any treatment**

And these are not upsetting statistics, they are real people.

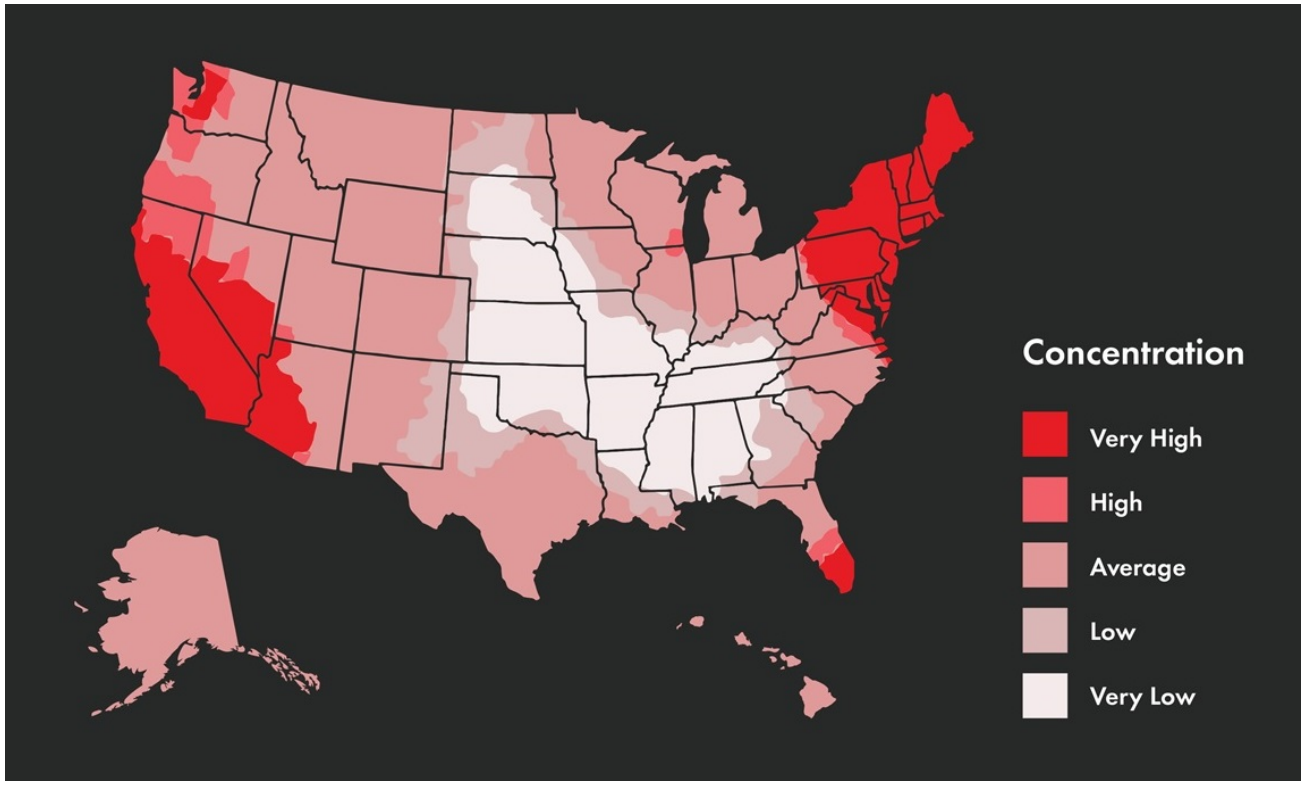
One of them was Victor Kittleson, the kindhearted and sentimental brother of one of my graduate students, who died from an opioid overdose this past summer.

This failure to treat is even more troubling for vulnerable groups. Black and LatinX adults receive mental healthcare services at only half the rate of whites.

And similar mental healthcare disparities exist for people living in rural communities and for those with lower incomes.

Access , **acceptability**, and **availability** - these are the factors that undermine our mental healthcare system.

While caring for my mom at home, my dad's **access** to mental healthcare was limited by its high cost without health insurance through a job.



But geography also impacts access. For example, consider the **access** to mental healthcare for the farmer in rural Kansas, when more than 90% of all psychologists and psychiatrists and 80% of social workers work exclusively in metropolitan areas and predominately on the coasts.

But even if my dad had had access to treatment, it likely wouldn't have been **acceptable** to him. Like many men of his generation, asking for help from others and sharing personal problems wasn't his strong suit.

But **even our family** never discussed it. It was the elephant in the room. Making ourselves vulnerable to therapists and to each other is hard.

And it is harder still because of the stigma that surrounds mental illness even today.

Mental healthcare services are often not **available** when we need them most. Many well-regarded therapists have long wait lists that can delay the start of treatment for months.

And once we make it off the wait list, treatment typically involves weekly, monthly, or even less frequent appointments with a therapist. But our mental health needs aren't limited to these pre-scheduled appointments.

Would a therapist have been available to my dad at his moments of greatest need - when he lost a job due to downsizing, or shortly after my mom's accident, or on the many dark mornings when he woke up with his hands shaking and had to decide if he was going to drink again to steady them?

Access, acceptability, and availability - these issues are undermining the treatment capacity of our mental healthcare system and leaving millions without treatment when they need it most.

Fortunately, digital therapeutics, and in particular, digital therapeutics **delivered on smartphones and made smarter still by personal sensing technologies**, are now emerging to target these very same three issues.

But let me pause for a moment. I want to be very clear on one point before we move forward. I do not believe or hope that digital therapeutics will replace human therapists.

Therapists will always be needed for what they do uniquely well. We simply need more than they can provide alone. Digital therapeutics can provide that "more."

Digital Therapeutics

So what are digital therapeutics?

Digital therapeutics are software programs or "apps" that are designed to prevent, manage, or treat disease, including mental illness.

Digital therapeutics are delivered to patients on their smartphones and this is the key to their accessibility and availability.

Today, 85% of adults in the U.S. own smartphones. And equally important, ownership is similarly high regardless of race, ethnicity, income, and geography.

Most of us now carry these pocket-sized, powerful computers with us everywhere we go.

And its this widespread use of smartphones that allows digital therapeutics to provide support

- 24 hours a day,
- 7 days a week,
- every day of the year,
- regardless of where we live

Some of the best examples of these digital therapeutics have been developed to target substance use disorders. These apps include multiple supports for patients during their treatment and recovery.

For example, if you need formal treatments, they have you covered. The apps include cognitive behavioral therapy and mindfulness-based relapse prevention

If you need peer support, the apps include discussion forums with other patients.

The apps can also help you locate self-help groups like AA or NA in your community.

The apps can help you track your symptoms over time and your symptoms can even be shared with your therapist if you opt to do so through the apps' clinician dashboard.

And these are just a few examples of the many supports that are possible to provide to patients with digital therapeutic apps.

Of course, all of this would be meaningless if digital therapeutics were not effective.

But they are.

For example, patients with substance use disorders who use a digital therapeutic have almost double the odds of being abstinent from alcohol or other drugs.

These increases in abstinence from using digital therapeutics are observed not only when compared to patients on wait lists, who have yet to gain access to treatment but also when digital therapeutics are added on top of traditional treatments for substance use disorders.

And these benefits are durable - they have been documented up to 12 months after the start of treatment.

This is a big deal. The magnitude of these benefits are meaningful already, even when we only think about a single patient using the app.

But their true power is in their scale, when the benefits from these apps are multiplied because they are provided simultaneously to millions of people in need and at relatively low cost.

OK, so lets call the apps I have described to you so far, the beta version of digital therapeutics. Their power comes from easy, 24/7 access to their many supports - their treatments, tools, and services.

But this is also their Achilles heel. As the patient using these apps, you now have to tackle difficult questions like:

- When should I use them?
- For how long?
- Which of their many supports are best for me?
- And which are best for me **right now**, at this moment in time?

My research team became interested in these issues when my colleague Dave Gustafson, the developer of a leading digital therapeutic for substance use disorders, approached us with a simple question. He asked…

> "Could you predict not only who might be at greatest risk for relapse but **precisely when** that relapse might occur and **how best to intervene** to prevent it"

Dave had just completed a large study demonstrating the effectiveness of his app. However, he also noticed many of the people who relapsed hadn't used the app in the days leading up to that relapse. And others who had relapsed hadn't used the specific supports in the app that he would have thought would be most effective for them.

He believed that the benefits of his app could be increased if the app knew the person well enough to recognize when they were at greatest risk for relapse and if it was smart enough to recommend the specific supports that would be most effective for them at that moment in time to prevent that relapse.

And I agree with him. The next wave of digital therapeutics, **smart digital therapeutics**, must learn to know us better as individuals, not just patients with the same crude diagnosis and same treatment needs at all times.

And these apps will do this through the use of built-in artificial intelligence algorithms that are powered by **personal sensing**.

Smarter Digital Therapeutics with Personal Sensing

Now you may not have heard the term "personal sensing" before, you have almost certainly seen it in action.

I'm a running nut, and for me, ads for trail running shoes, the latest running backpacks, or the newest fancy water bottles follow me around everywhere.

While preparing for TEDx this fall, I've been bombarded with ads for books, videos, and classes to improve my public speaking.

Currently, personal sensing uses our personal data to target ads at us to sell us things. But we hope to empower people to use personal sensing to improve their mental healthcare instead.

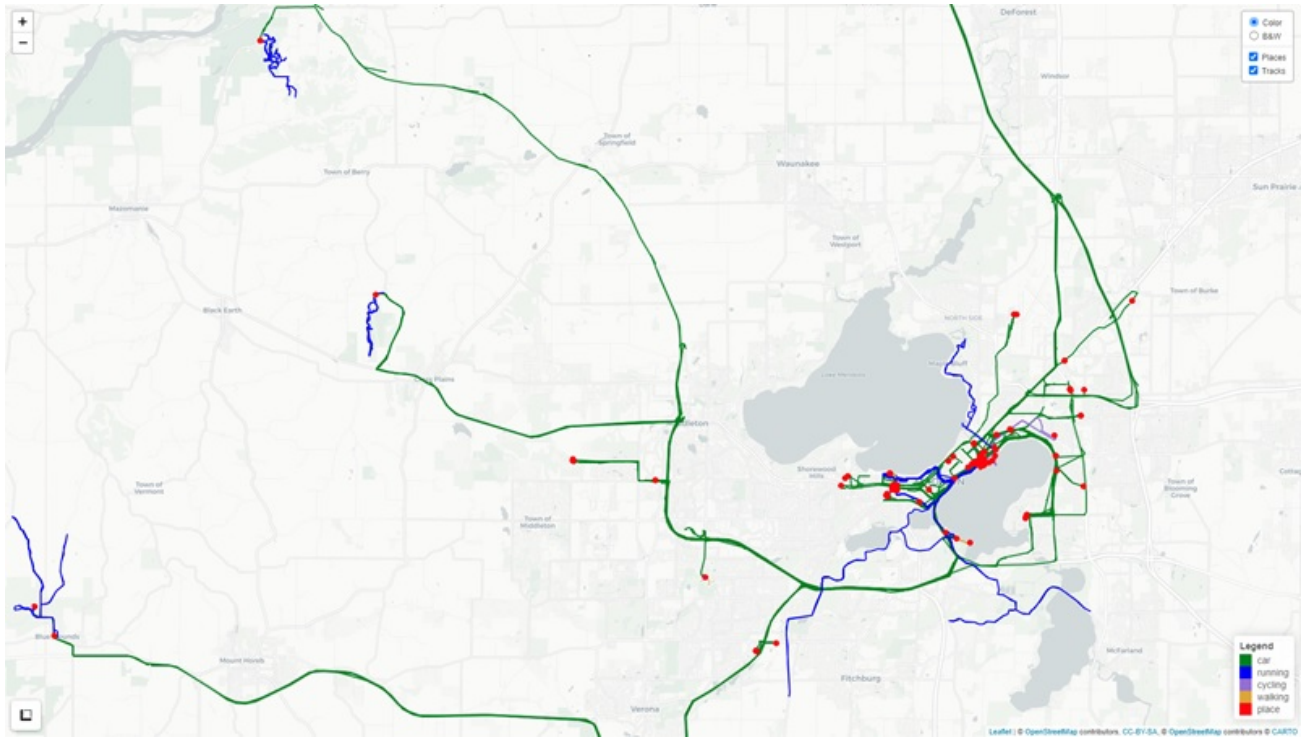
Personal sensing has been supercharged by smartphones.

We use our smartphones to make phone calls and text messages. We often access and post to our social media accounts from our smartphones.

Smartphone-embedded sensors know our moment-by-moment location and activity level. Sensors can even detect other people, or at least their smartphones, in our immediate environment.

Personal sensing passively captures all this information and more to understand our recent experiences, preferences, and behaviors. It can be used to predict how we feel right now, and even how we may feel or behave in the future.

Let’s take a look at two of the more revealing personal sensing methods that my laboratory is developing to provide you with some intuition about how this works.

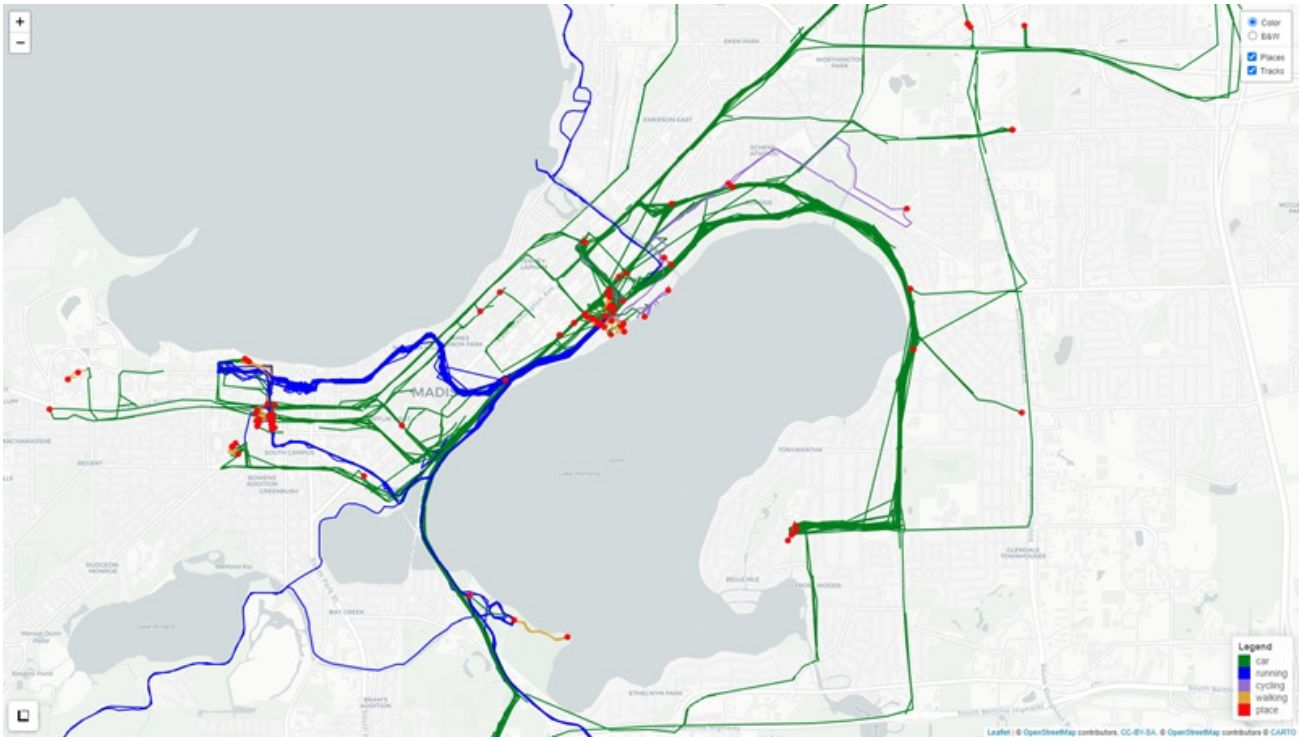


Behind me is a wide view of my moment-by-moment location detected by a digital therapeutic app over a month when we were first experimenting with this sensing method. The app recorded the paths that I traveled, with movement by car in green and running in blue.

The red dots indicate places that I stopped to visit for at least a few minutes.

And although not displayed here, the app knows the days and exact times that I was at each of these locations.

The app can immediately see that I am runner, with long runs leaving from downtown Madison and frequent trail runs on the weekends in the county and state parks to the west and northwest.



Zooming in to the Madison isthmus, the app can see that I drive my children halfway around the lake each morning to their elementary school. And it could detect those stressful mornings when getting my young kids dressed and fed didn't go as planned and we were late, sometimes **very late**, to school!

The app recorded my daily running commute through downtown Madison to and from my office. From this, it can observe my longs days at the office and also those days that I skipped out.

Looking at the red dots indicating the places I visit, the app can detect the restaurants, bars, and coffee shops where I eat, drink and socialize. It can use public map data to identify these places and make inferences about what I do there.

The app also collected my smartphone communications logs and even the content of my text messages. And no such luck, I don't plan to show you my actual text messages!

But imagine what it learned about me from the patterns of my communications - Who I was calling, when I made those calls, and even the content of what I sent and received by text message.

The app can improve its predictions about us even further by identifying the specific people and places that make us happy or sad or stressed, those that we perceive support our mental health and those who undermine it.

It can gather this information quickly by asking us a few key questions about the people and places it sees us interact with frequently over the first couple of months that we use the app.

For example, if my dad was using this app, it would see that he calls and texts frequently with his close friend, Ed. My dad would report that Ed has been a lifelong source of stability and support.

Given this, the app would know my dad is doing well when he spends time at Ed's house, when they call and text each other to plan activities, when they go for daily walks along the beach by the Long Island Sound.

It could also detect when time spent with Ed abruptly stops each fall because Ed spends his winters in Florida. These months are harder for my dad and he would benefit from more support.

The app could encourage him to reach out to other supportive family and friends during these months. It could provide him with locations and meeting times for support groups in his community. He could even be assisted to build community in the discussion forums within the app itself.

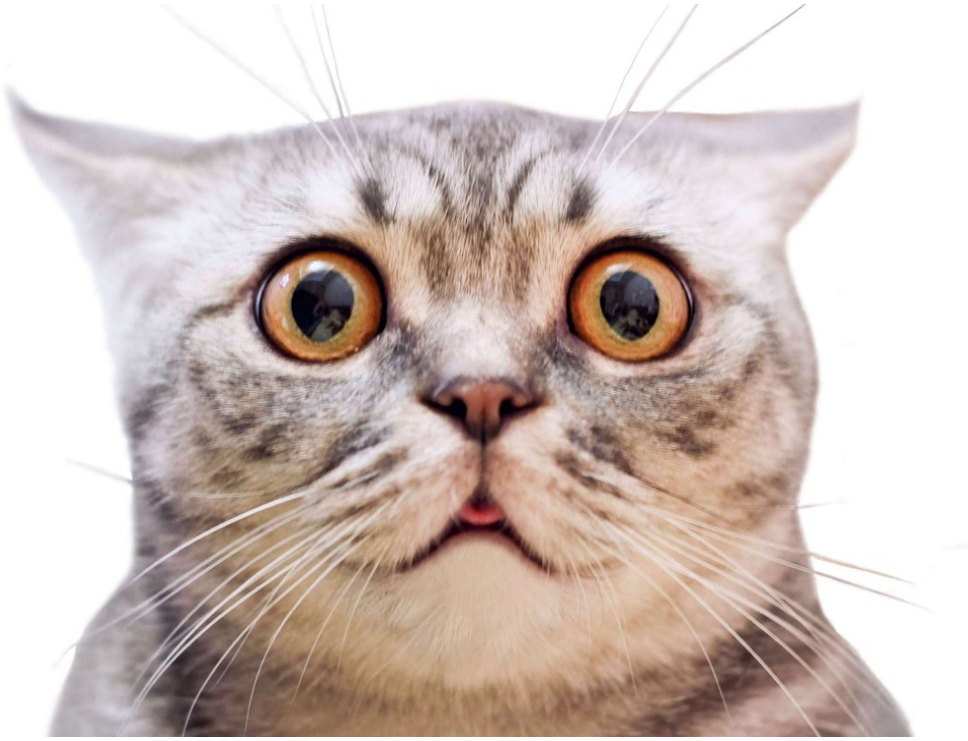
If the app knew him well, it might even recommend which of these forms of support would be most effective for him.

If he had also received traditional mental healthcare, he might have given permission for the app to share information with his therapist. His therapist might then increase their support when my dad during the months when he is more isolated but direct their support preferentially to other patients when my dad was more stable and supported by his healthy friends and family.

In our research studies, our algorithms can already predict with relatively high accuracy if someone in recovery will relapse back to drinking **tomorrow** based on personal sensing of their recent **past** experiences and behaviors. **This is exciting and an important start**.

But these are **preliminary** research studies. And they included mostly white participants from our local Madison community. Personal sensing algorithms trained on these participants would be unlikely to work well with black and brown patients or patients from rural communities.

Personal sensing algorithms must be trained on diverse samples of patients or their use may exacerbate rather than reduce existing mental healthcare disparities. Our **current studies** now specifically recruit for racial, ethnic, and geographic diversity across the entire United States.



I also suspect that at some point, probably about five minutes ago, you thought:

> "Holy crap, this is really private information that these apps would collect from me. Who will have access to it and what will they do with it?"

Most of us are all too familiar with recent serious privacy violations like the Cambridge Analytica scandal and the Pegasus Spyware scandal.

Given this, you might be surprised to hear me say that I am generally optimistic that we will get these privacy issues resolved, at least narrowly in the context of digital therapeutic apps. I'm not making any promises for other apps on your phone or god forbid, Facebook! You're on your own there…..

So here's why I'm optimistic. In the last five years, the FDA has recognized both the potential benefits and risks posed by digital therapeutics.

In response, the FDA has begun to regulate software, including smartphone apps, as it does other medical devices if the purpose of that software is to prevent, manage, or treat disease.

This means that the FDA now evaluates the effectiveness and risks, including privacy risks, of digital therapeutics before clearing them for use with patients.

These FDA policy changes are huge and they begin to situate digital therapeutics squarely within healthcare, where privacy protections have been considered paramount.

Digital therapeutics are here **today**. The FDA has already cleared the first two digital therapeutics for substance use disorders. Our nation's VA Medical Centers have developed digital therapeutics to treat other mental illnesses. And the VA is providing their apps for free to everyone, not just veterans, through their VA mobile health website. If you need more care than you are receiving now, download and try these apps.

However, remember that the beta versions of digital therapeutics that are available today are still improving. But as they get smarter through personal sensing, better mental healthcare is within our reach. Smart digital therapeutics can deliver the right treatments, at the right time, every time, and for all of us.

My dad did not receive the mental healthcare he needed. Neither did Victor Kittleson. With smart digital therapeutics, I hope that we can tell a different story for you and your family and friends.