

Digital Health Trends

Assessing the current state of telemedicine, wearables, and mobile health technology.

Digital health—leveraging digital technologies to improve human health—is a growing and evolving space.

When deployed within healthcare, digital technology offers the promise of building a healthcare system without walls: a system that can deliver personalized care when and where it's needed.

The real power of digital health will come from having an integrated ecosystem of sensors, provider knowledge, and care delivery options that provide tailored, personalized, and on-demand care—just as digital technology has provided this level of service for other sectors like the banking, retail and transportation industries.

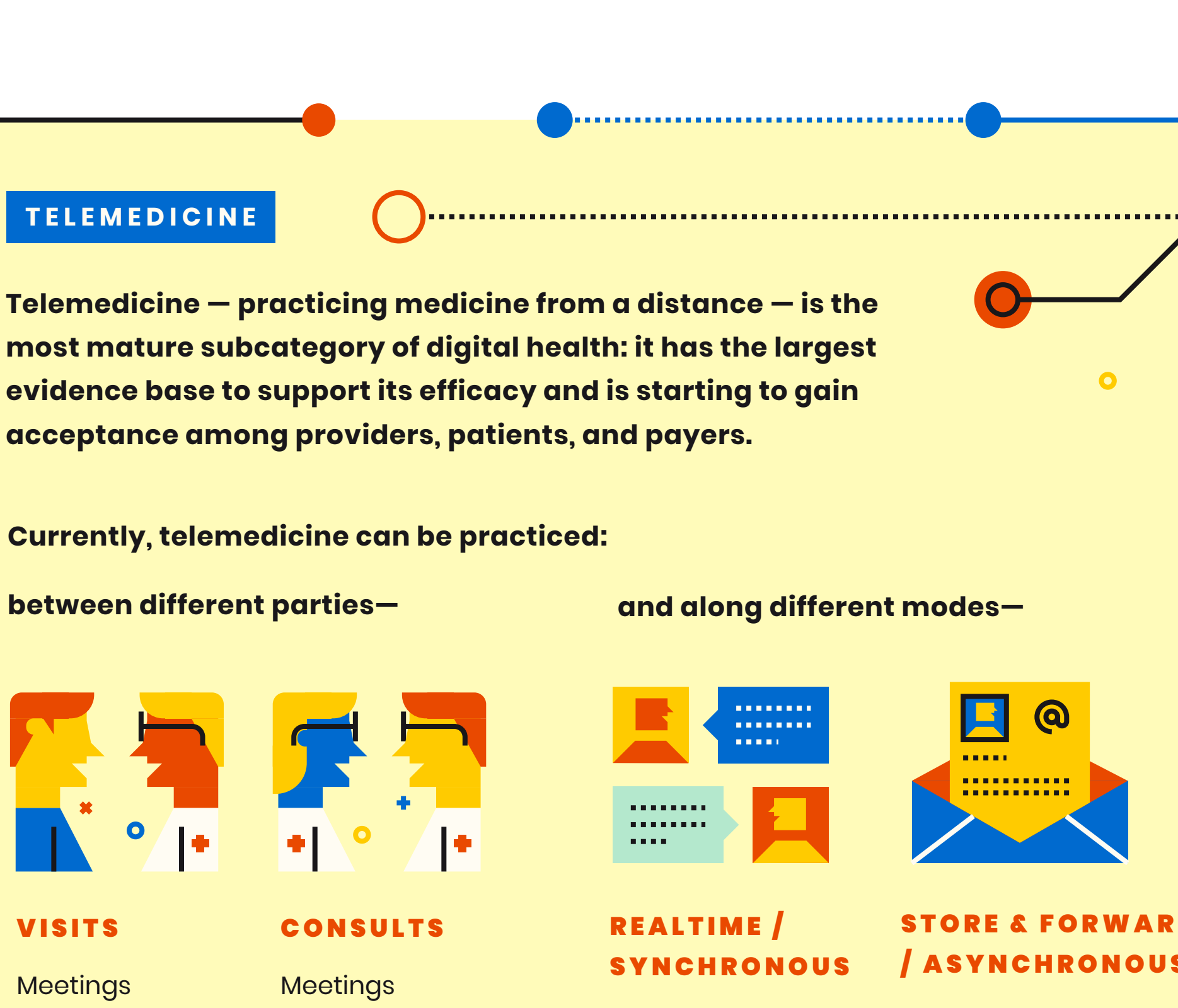
Despite the promise of this technology, an integrated, digital health system has not yet been realized, for the following reasons:

Healthcare is highly regulated, making it challenging to design solutions that work across geographies, health conditions, and delivery methods.

The current market is fragmented and full of point solutions that address very specific problems, rather than fully integrated solutions.

Digital health tools offer the promise of healthcare that takes place outside the clinic, but it's still unclear how these services fit into a healthcare system that is still mostly fee for service.

All this means that examining specific products and services provides limited insights about the opportunities digital health offers. Instead, we focused on strategic organizing frameworks to yield insights that will persist beyond the latest products. We did this for three of the largest categories within digital health:



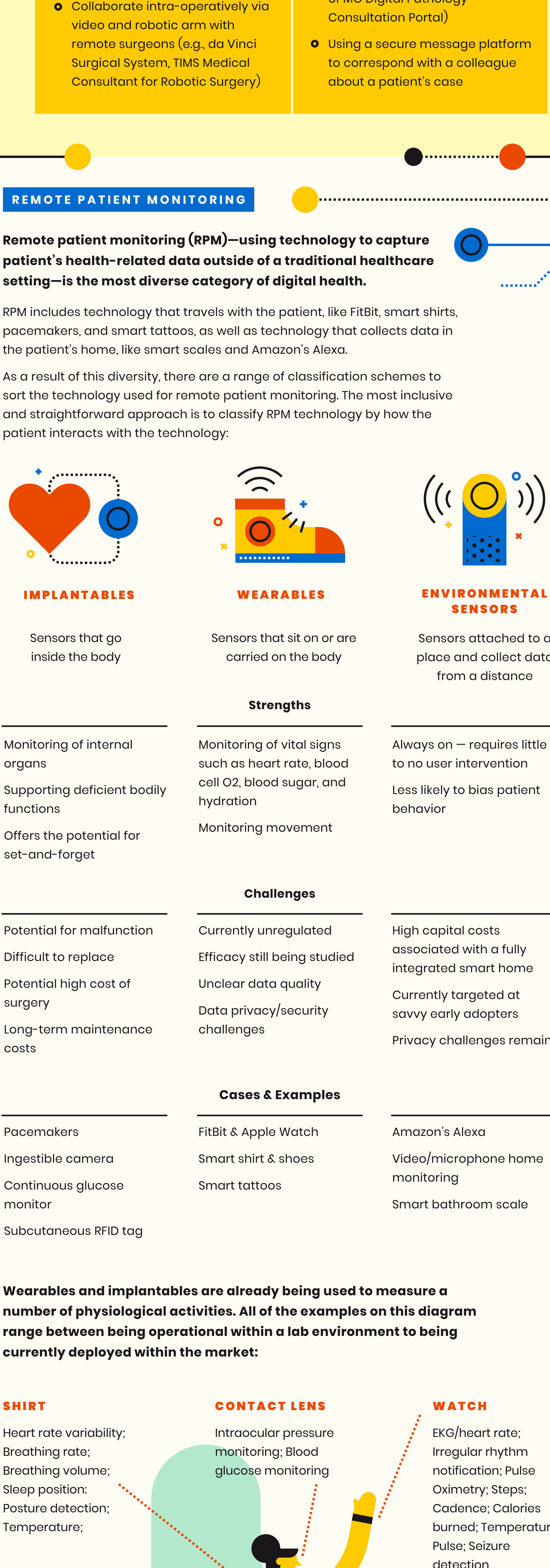
TELEMEDICINE

Telemedicine — practicing medicine from a distance — is the most mature subcategory of digital health: it has the largest evidence base to support its efficacy and is starting to gain acceptance among providers, patients, and payers.

Currently, telemedicine can be practiced:



Each of these can be combined for four different scenarios:

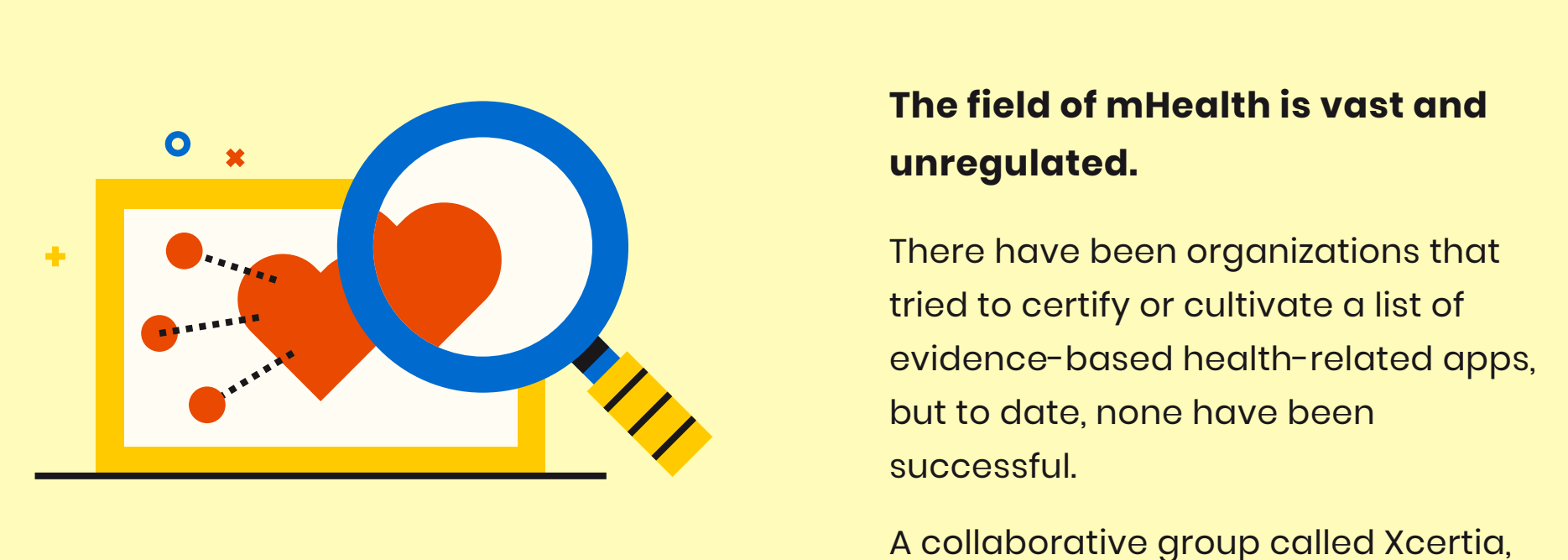


REMOTE PATIENT MONITORING

Remote patient monitoring (RPM)—using technology to capture patient's health-related data outside of a traditional healthcare setting—is the most diverse category of digital health.

RPM includes technology that travels with the patient, like FitBit, smart shirts, pacemakers, and smart tattoos, as well as technology that collects data in the patient's home, like smart scales and Amazon's Alexa.

As a result of this diversity, there are a range of classification methods to sort the technology used for remote patient monitoring. The most inclusive and straightforward approach is to classify RPM technology by how the patient interacts with the technology:

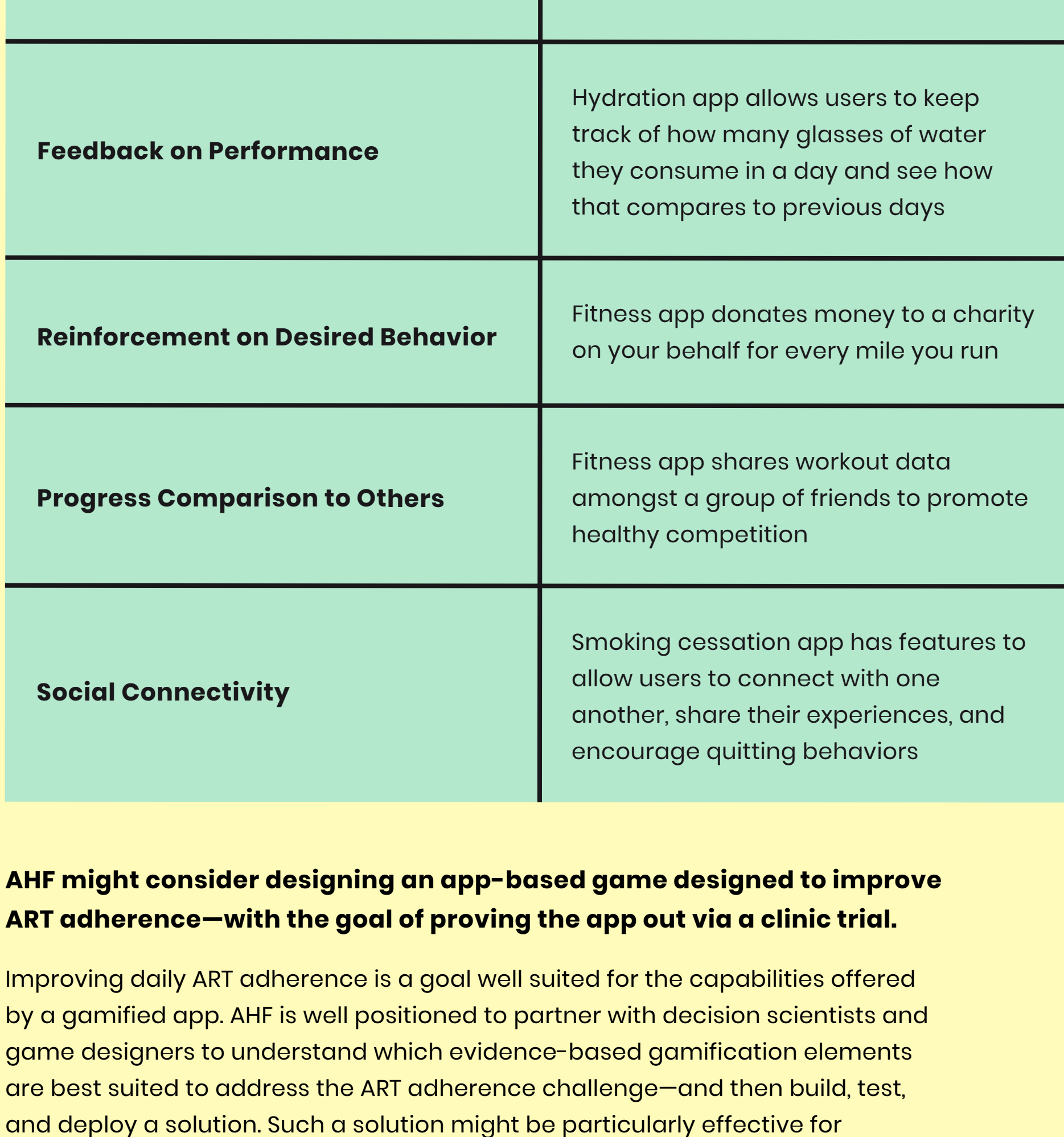


Strengths		
Monitoring of internal organs	Monitoring of vital signs such as heart rate, blood cell O2, blood sugar, and hydration	Always on — requires little to no user intervention
Supporting deficient bodily functions	Monitoring movement	Less likely to bias patient behavior
Offers the potential for set-and-forget		

Challenges		
Potential for malfunction	Currently unregulated	High capital costs associated with a fully integrated smart home
Difficult to replace	Efficacy still being studied	Currently targeted at savvy early adopters
Potential high cost of surgery	Unclear data quality	Privacy challenges remain
Long-term maintenance costs	Data privacy/security challenges	

Cases & Examples		
Pacemakers	FitBit & Apple Watch	Amazon's Alexa
Ingestible camera	Smart shirt & shoes	Video/microphone home monitoring
Continuous glucose monitor	Smart tattoos	Smart bathroom scale
Subcutaneous RFID tag		

Wearables and implantables are already being used to measure a number of physiological activities. All of the examples on this diagram range between being operational within a lab environment to being currently deployed within the market:



MOBILE HEALTH

Mobile health (mHealth) are the patient-facing mobile phone and tablet apps designed to improve patient health, including apps that allow patients to track their emotional health, measure heart rate, and those that try to modify behavior, like smoking cessation and exercise.

Our research found that mobile health apps are still an emerging field without sufficient evidence or coordination for industry-wide adoption:

The evidence base for mHealth effectiveness is still emerging.

While mHealth efficacy studies often have positive results, systematic reviews of the literature often find mixed results and call for more rigorous randomized control trial (RCT) study design. Multiple systematic reviews have found that existing mHealth studies tend to be pilot studies with small samples and short intervention and data collection periods.

The field of mHealth is vast and unregulated.

There have been organizations that tried to certify or organize a list of evidence-based health-related apps, but to date, none have been successful.

A collaborative group called Xcertia, which includes the American Medical Association, the American Heart Association, and the Healthcare Information and Management Systems Society, is currently developing mHealth app guidelines with the goal of helping people achieve their health and wellness goals.

Gamification is one area within mHealth that is both promising and relevant for AHF's patient population.

Gamification is the use of game design elements in non-game contexts, which can be used to change behavior using evidence-based practices. Within healthcare settings, apps have used gamification to help patients adhere to new care routines, such as taking a daily pill or injection. This suggests that gamification might be a useful tool for improving adherence within certain patient populations.

Behavioral science researchers and game designers use several tools to motivate user decisions and affect behavior:

GAMIFICATION TOOL	EXAMPLE CASE
Goal Setting	Fitness app asks users to set a goal for the number of steps they take in a day
Action Planning to Overcome Challenges	Healthy eating app gives users points if they create a meal plan for the week to minimize poor food choices
Feedback on Performance	Hydration app allows users to keep track of how many glasses of water they consume in a day and see how that compares to previous days
Reinforcement on Desired Behavior	Fitness app donates money to a charity on your behalf for every mile you run
Progress Comparison to Others	Fitness app shares workout data amongst a group of friends to promote healthy competition
Social Connectivity	Smoking cessation app has features to allow users to connect with one another, share their experiences, and encourage quitting behaviors

AHF might consider designing an app-based game designed to improve ART adherence—with the goal of proving the app out via a clinic trial.

Improving daily ART adherence is a goal well suited for the capabilities offered by a gamified app. AHF is well positioned to partner with decision scientists and game designers to understand which evidence-based gamification elements are best suited to address the ART adherence challenge—and then build, test, and deploy a solution. Such a solution might be particularly effective for engaging with a younger, more rural population that doesn't have as much access to clinics.

We relied on a large number of sources to inform this research summary, and a complete list is contained within a separate, annotated bibliography. A few of these sources provided us with some key ideas, and we acknowledge them below.

Telemedicine framework
ClearHealth Quality Institute, Telemedicine Accreditation Program (TAP) Standards and Guide.
National Consortium of Telehealth Resource Centers. (2018). What is Telehealth?: Context for Framing Your Perspective.

Strengths and weaknesses of Remote Patient Monitoring
Vorshney, Upkar. (2014). Mobile health: Four emerging themes of research. Decision Support Systems, 66, 20–35. doi: https://doi.org/10.1016/j.dss.2014.08.001

Technology readiness of wearables
Andreu-Perez, Javier, Leff, Daniel R, Ip, Henry MD, & Yang, Guang Zhang. (2016). From wearable sensors to smart implants—toward pervasive and personalized healthcare. IEEE Transactions on Biomedical Engineering, 62(12), 2760–2782.

Current state of mobile health technology
Cooper, Vanessa, Okonkwo, June, Whitham, Jennifer, & Consortium, EMERGE. (2017). mHealth interventions to support self-management in HIV: a systematic review. The Open AIDS Journal, 11, 119.

Byambasuren, Oyungere, Sanders, Sharon, Boller, Elaine, & Glasziou, Paul. (2018). Prescribable mHealth apps identified from an overview of systematic reviews. npj Digital Medicine, 1(1), 12. doi: 10.1038/s41746-018-0021-9

Wang, Youfa, Xue, Hong, Huang, Yaqi, Huang, Lili, & Zhang, Dongsong. (2017). A Systematic Review of Application and Effectiveness of mHealth Interventions for Obesity and Diabetes Treatment and Self-Management. Advances in Nutrition, 8(3), 449–462. doi: 10.3945/an.116.014000

Xcertia. (2019). mHealth App Guidelines. from xcertia.org

Gamification
Deterring, Sebastian, Dixon, Dan, Khaled, Rilla, & Nacker, Linnard. (2010). From game design elements to gamification: defining "gamification". Paper presented at the Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments, Tampere, Finland.

Hightow-Weidman, Lisa, Muessig, Kathryn, Knudtson, Kelly, Srivatsa, Mala, Lawrence, Elaina, LeGrand, Sara, ... Hesse, Sybil. (2018). A Gamified smartphone app to support engagement in care and medication adherence for HIV-positive young men who have sex with men (AlyQuest): development and pilot study. JMIR public health and surveillance, 4(2), 34.

Johnson, Daniel, Deterring, Sebastian, Kuhn, Karri-Ann, Stanava, Aleksandra, Stoyanov, Stoyan, & Hides, Leanne. (2016). Gamification for health and wellbeing: A systematic review of the literature. Internet Interventions, 6, 89–106.