# $\bigcirc$ **Digital Health Trends**

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

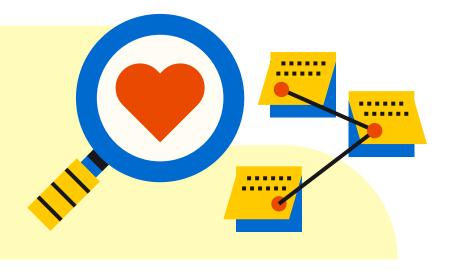
# **Digital health—leveraging digital technologies to** improve human health—is a growing and evolving space.

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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.

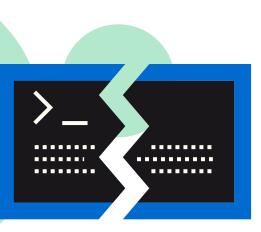
The real power of digital health will come from having an integrated ecosystem of sensors, provider knowledge, and care delivery options that provide tailored, personalized, and on-demand care-just as digital technology has provided this level of service for other sectors like the banking, retail and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

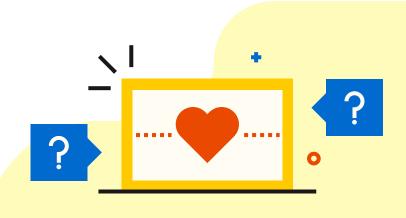
**Digital health is receiving significant** attention right now, but the evidence base is still developing and the field is relatively new compared to the field of medicine as a whole.

Medical groups and hospital systems have been tentative to adopt new solutions.



Much of the existing healthcare system is built on legacy IT systems that were not designed to easily integrate new solutions from multiple vendors.

Integrating new solutions is challenging, so the system remains stovepiped.



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:



Practicing medicine from a distance in time, space, or both

TELEMEDICINE



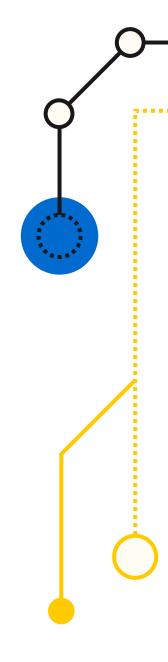
#### REMOTE PATIENT MONITORING (RPM)

Capturing patient's health-related data outside of a traditional healthcare setting



E HEALTH (mHEALTH)

Patient-facing mobile phone apps designed to improve patient health



IMAGINATIVE FUTURES

#### TELEMEDICINE

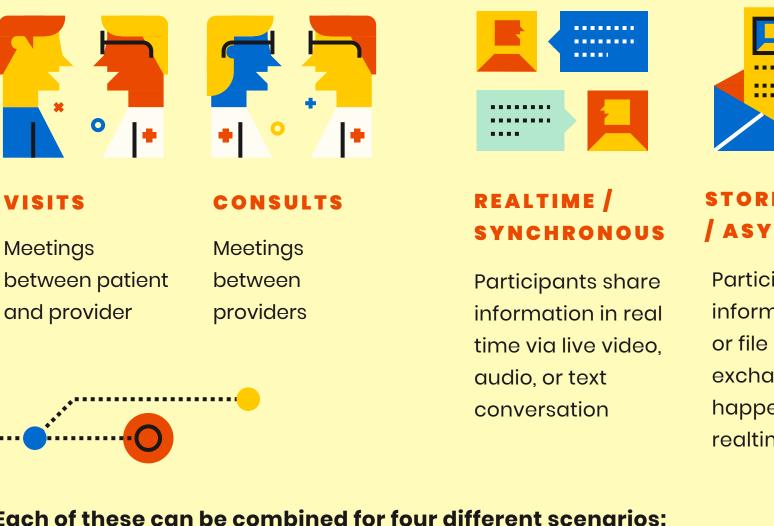
Telemedicine – practicing medicine from a distance – is the most mature subcategory of digital health: it has the largest evidence base to support its efficacy and is starting to gain acceptance among providers, patients, and payers.

#### Currently, telemedicine can be practiced:

between different parties-

STISIV

CONSULTS



# Participants share exchange that

and along different modes-



#### STORE & FORWARD **ASYNCHRONOUS**

information via email or file sharing, in an happens slower than realtime.

	REALTIME / SYNCHRONOUS	STORE & FORWARD / ASYNCHRONOUS
	A (real-time) video visit between patient & provider	A virtual exchange of medical info between patient & provider
++	<ul> <li>Great for:</li> <li>Mental health visits</li> <li>Triage</li> <li>Flexible scheduling &amp; geography</li> <li>Not great for:</li> <li>Exams that require touching</li> <li>Visits that require lab draws</li> <li>Examples</li> <li>Remote urgent care visit via video from the comfort of home (e.g., MDLive, Doctor on Demand, Amwell)</li> <li>Using a telemedicine platform at a rural primary care provider's office to connect with a specialist at a distance</li> </ul>	<ul> <li>Great for:</li> <li>Teledermatology</li> <li>Post-diagnosis follow up questions</li> <li>Post-procedure care instructions</li> <li>Not great for:</li> <li>Emergent situations</li> <li>Exams that require touching</li> <li>Examples</li> <li>Mental health care via secure text message (e.g., Talkspace, BetterHelp, ReGain)</li> <li>Monitoring post-operative wound healing via machine learning-enhanced photo sharing (e.g., Parable Health)</li> </ul>
		sharing (e.g., r arabie health)
	A (real-time) video visit between provider & provider	An online exchange between providers
		An online exchange
+	between provider & provider	An online exchange between providers
	between provider & provider Great for:	An online exchange between providers Great for: + Teledermatology + Post-diagnosis follow up questions
+	between provider & provider Great for: • Emergent situations • Ambulance services • Access to specialties	An online exchange between providers Great for: + Teledermatology
+	between provider & provider Great for: Emergent situations Ambulance services	An online exchange between providers Great for:
++	between provider & provider Great for: • Emergent situations • Ambulance services • Access to specialties	An online exchange between providers Great for: 4 Teledermatology 4 Post-diagnosis follow up questions 5 Post-procedure care instructions Mot great for:
++++	<ul> <li>between provider &amp; provider</li> <li>Great for:</li> <li>Emergent situations</li> <li>Ambulance services</li> <li>Access to specialties</li> <li>"Talking through" a procedure</li> </ul>	An online exchange between providers Great for:
++++	<ul> <li>between provider &amp; provider</li> <li>Great for:</li> <li>Emergent situations</li> <li>Ambulance services</li> <li>Access to specialties</li> <li>"Talking through" a procedure</li> <li>Not great for:</li> </ul>	An online exchange between providers Great for: • Teledermatology • Post-diagnosis follow up questions • Post-procedure care instructions Not great for: • Emergent situations
+ + +	<ul> <li>between provider &amp; provider</li> <li>Great for:</li> <li>Emergent situations</li> <li>Ambulance services</li> <li>Access to specialties</li> <li>Talking through" a procedure</li> <li>Not great for:</li> <li>Consults requiring touch labor</li> </ul>	An online exchange between providers Great for: • Teledermatology • Post-diagnosis follow up questions • Post-procedure care instructions Dot great for: • Emergent situations • Exams that require touching

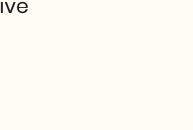
### **REMOTE PATIENT MONITORING**

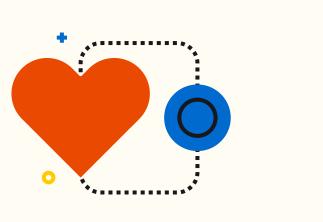
Remote patient monitoring (RPM)—using technology to capture patient's health-related data outside of a traditional healthcare setting—is the most diverse category of digital health.

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 schemes 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:









IMPLANTABLES

Sensors that go inside the body

Monitoring of internal organs

Supporting deficient bodily functions

Offers the potential for set-and-forget

Potential for malfunction Difficult to replace

Potential high cost of surgery

Long-term maintenance costs

**Pacemakers** 

Ingestible camera

Continuous glucose monitor

Subcutaneous RFID tag

#### WEARABLES

Sensors that sit on or are carried on the body

#### Strengths

Monitoring of vital signs such as heart rate, blood cell O2, blood sugar, and hydration

Monitoring movement

#### Challenges

Currently unregulated

Efficacy still being studied

Unclear data quality Data privacy/security challenges

#### Cases & Examples

FitBit & Apple Watch Smart shirt & shoes

Smart tattoos

ENVIRONMENTAL SENSORS

Sensors attached to a place and collect data from a distance

Always on – requires little to no user intervention Less likely to bias patient behavior

High capital costs associated with a fully integrated smart home

Currently targeted at savvy early adopters Privacy challenges remain

Amazon's Alexa

Video/microphone home monitoring

Smart bathroom scale

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:

#### SHIRT

Heart rate variability; Breathing rate; Breathing volume; Sleep position: Posture detection; Temperature;

#### PACEMAKE

Heart electrical activity, heart rhythm, blood temperature, breathing rate

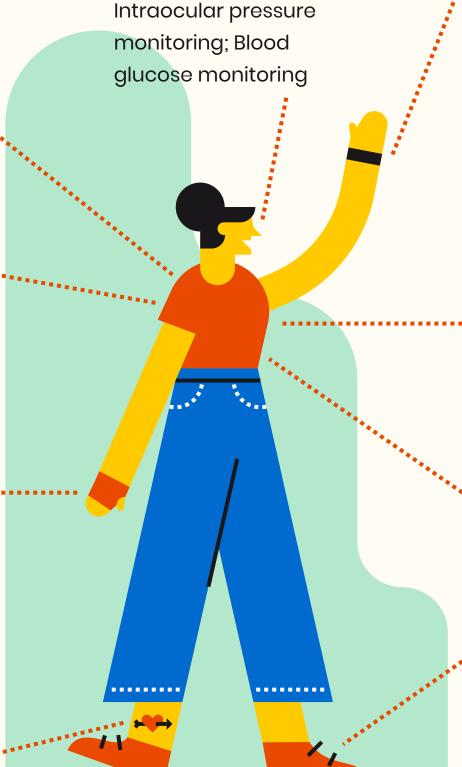
#### GLOVER

Measure tremors (in Parkinson's patients); Measure rigidity (in Parkinson's patients); Hand functioning assessment

#### TATTOO

Dehydration; Blood glucose level; Temperature;

**CONTACT LENS** 



#### WATCH

EKG/heart rate; Irregular rhythm notification; Pulse Oximetry; Steps; Cadence; Calories burned; Temperature; Pulse: Seizure detection

#### BRA

Ultrasound of breast tissue

INGESTIBLE

CAMERA

Endoscopy

SHOE

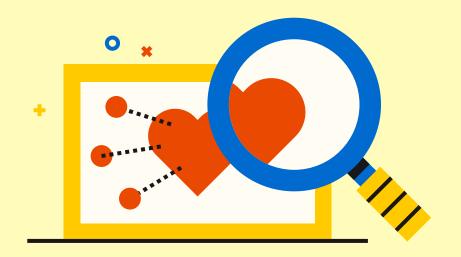
Distance walked; Speed; Cadence/Gait; Abnormal movement (fall); Calories burned; Skin breakdown detection for people with diabetes

#### 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

#### The field of mHealth is vast and unregulated.

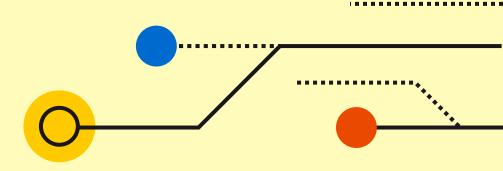
There have been organizations that tried to certify or cultivate a list of evidence-based health-related apps, but to date, none have been successful.

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.



#### 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.



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

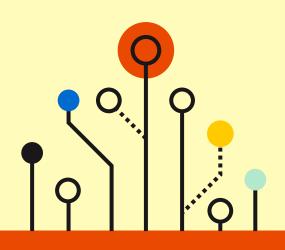
Gamification is the use of game design elements in non-game contexts, which can be used to change behavior using evidence-based practices. Within healthcare settings, apps have used gamification to help patients adhere to new care routines, such as taking a daily pill or injection. This suggests that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

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