The promise of mobile health (mHealth), the use of mobile devices to support the practice of medicine and public health, is profound but, as yet, unrealized. mHealth strategies, however, are not “one-size-fits-all.”

Executive summary
By leveraging the power and reach of mobile communications, mHealth makes it possible to provide a more versatile and personalized approach to health care. However, in order for mHealth to reach its full potential, four critical dimensions must align: people, places, payment, and purpose.

People: Demographics
A nuanced understanding of demographics such as age, gender, and income can point to technology preferences and help drive customization and targeting of users’ mHealth experiences.

Places: Local infrastructure
The convergence of infrastructure needs (reliable local networks – cellular, broadband and wireless, download speeds, and bandwidth capacity) and rapid technological development may be a tipping point for mHealth adoption.

Payment: Reimbursement and regulatory
Value-based reforms are prompting health care organizations to 1) find more efficient ways to improve care while increasing quality; 2) expand care delivery outside the hospital and physician office; 3) facilitate patient-provider connectivity “anytime and anywhere”; and 4) increase patient engagement. Addressing privacy and security concerns, as well as reimbursement approaches and regulatory consistency across jurisdictions, should remove several existing barriers to adoption.

Purpose: Disease dynamics
Fitness, wellness, care provision, disease management, and complex case management can be supported by mHealth functionality, but the approach has to fit the condition.
Key takeaways
Health care organizations – providers, payers, and life sciences companies – should consider each of the four dimensions of mHealth as they weigh market entry (See Figure 1). Among important considerations:

- **Personalize the consumer’s experience.** mHealth offers tools – consumer engagement strategies, retail capabilities based upon mobile platforms and data analytics, digitization of an individual’s wellness and health care needs, and more – that can enable competitive differentiation by creating personalized solutions that help drive consumer loyalty.

- **Keep it simple.** mHealth functionality should be easy to use and akin to users’ mobile experiences in hospitality, retail, travel, and banking.

- **Pay attention to privacy and security.** mHealth technologies and permeable boundaries among existing and new entrants in the health care ecosystem increase the complexity of managing protected health information (PHI). Organizations need to be secure, vigilant, and resilient in the face of threats to information security.

Figure 1: The four dimensions of effective mHealth
**People: Demographics**

A nuanced understanding of demographics such as age, gender, and income can point to technology preferences and help drive customization and targeting of users’ mHealth experiences.  

mHealth programs should be designed to be operable via multiple communication platforms and channels such as phones, tablets, laptops, and social media.

- The platform for mHealth already exists. Smartphone ownership in the United States is at a high and still growing. Almost all U.S. adults own a cell phone, half of which are smartphones. And, over two in five (42 percent) own a tablet. On average, a U.S. adult carries three devices, with the most popular being a smartphone. Mobile devices are heavily used for connectivity; Internet usage among U.S. adult mobile phone owners is now at 63 percent, twice as high as in 2009, and at least half of owners have downloaded an application (app). One in three U.S. consumers has used their mobile phone to look for health information.

### Figure 2: Mobile device ownership (2012-2013)

#### Cell phone ownership

<table>
<thead>
<tr>
<th>Age</th>
<th>2012</th>
<th>2013</th>
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<td>50-64</td>
<td>83%</td>
<td>89%</td>
<td>6%</td>
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<tr>
<td>65+</td>
<td>65%</td>
<td>77%</td>
<td>12%</td>
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#### Smartphone ownership

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<tr>
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<td>79%</td>
<td>13%</td>
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<tr>
<td>30-49</td>
<td>59%</td>
<td>67%</td>
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<td>34%</td>
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<td>11%</td>
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<tr>
<td>65+</td>
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#### Tablet ownership

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<tr>
<td>65+</td>
<td>8%</td>
<td>18%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Source: Pew Summer Tracking Survey 2012; PEW Mobile Technology Fact Sheet 2014; PEW Tablet Ownership 2013
• Consumers have a growing interest in mHealth. Millennials (born 1982-1994), in particular, are already dabbling in the technology. They demonstrate a generational difference in interest – twice as many Millennials as overall respondents in a recent survey said they downloaded a health tracking app (19 percent of Millennials vs. 10 percent of all respondents). Similarly, one in four Millennials has used smartphones and tablet apps to manage and monitor their fitness and health improvement goals such as exercise or diet (25 percent of Millennials vs. 17 percent of all respondents).9

• Smartphone ownership by U.S. adults aged 50-65 years increased from 34 percent to 45 percent between 2012 and 2013 (Figure 2). Over the same period, smartphone ownership by Seniors (aged 65+ years) grew by seven percent. Baby Boomers (born 1946-1964), in particular, are expected to combine an interest in technology with substantial purchasing power to generate the fastest year-on-year growth in smartphone penetration in 2014.10 Around one in five Boomers has never downloaded an app vs. one in 10 of all age groupings. This may present both a challenge and an opportunity to carriers and health providers to engage this group in mHealth-oriented technologies and behaviors.10
In a health care environment which is rapidly moving towards being patient-centered, different consumer segments will likely demand that mHealth programs and delivery channels be tailored to their distinct user preferences.

• Deloitte has identified six unique consumer health care segments that navigate the health care system in very different ways (Figure 3). One segment, “online and onboard,” represents a more “active” health care consumer which, in comparison with other segments, has a strong preference to use online tools and mobile applications to locate providers and compare treatment options and provider qualities.

• In 2012, just under 20 percent of the younger generations, Millennials (born 1982-1994) and Gen X (born 1965-1981), and around 15 percent of the older generations, Baby Boomers (born 1946-1964) and Seniors (born 1900-1945), fell into the “online and onboard” segment.11

Figure 3: Six health care consumer segments – Online & Onboard

Online & Onboard
online learner; happy with care but interested in alternatives & technologies

- Millennials 18%
- Gen X 19%
- Boomers 15%
- Seniors 14%
- Sick & Savvy
  consumes considerable health care services & products; partners with physician to make treatment decisions
  14%
- Out & About
  independent; prefers alternatives; wants to customize services
  9%
- Casual & Cautious
  not engaged; no current need; cost-conscious
  4%
- Shop & Save
  active; seeks options and switches for value; saves for future health costs
  34%
- Content & Compliant
  happy with physician, hospital and health plan; trusting and follows care plans
  22%

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Places: Local infrastructure

- A lack of reliable local networks – cellular, broadband, and wireless – currently limit mHealth capabilities. However, increasing download speeds and bandwidth capacity should enable mHealth programs to leverage more advanced mobile functions.

- As mobile devices and their apps become more sophisticated, consume more data, and are almost constantly in use, they will likely require better, faster, and more widespread networks. Advances in technology, lower-priced subscriber plans, and longer device battery life have broadened consumer access to mHealth. The growing size of health data files as the transfer of technologies such as imaging products and remote monitoring become more prevalent is likely to drive future demand for bandwidth.

- Phone carriers are building out the next generation of networks, 4G LTE, which will likely enable faster response times, help resolve latency issues, and support higher-bandwidth applications such as video and high-definition imagery. However, this build-out will likely take time and large gaps currently exist (Figure 4).

- Telemedicine technologies offer access solutions for rural and underserved areas; however, many of these areas have broadband limitations. Physicians with small practices in remote areas have been identified as a key group limited by broadband gaps that render them unable to effectively use mHealth technologies in an environment ideal for mHealth.12

Figure 4: 4G LTE coverage map as of April 2014

Source: OpenSignal.com
Health care systems’ current readiness to manage and respond to incoming clinical data may slow realization of mHealth’s full potential.

• Interoperable systems and analytic capabilities are essential to enable health care organizations to utilize incoming streams of data. For example, mobile access to patient information was found to improve accessibility, productivity, and workflow in a Department of Veterans Affairs’ (VA) 2011 mobile health clinician pilot. An extension of this study will test how a suite of VA clinician apps built around mobile access to patient information affects accessibility, productivity, workflow, and communications across VA care teams.13

• Modeling of widespread adoption of interoperability among medical devices, electronic health records (EHRs), mobile devices, and health information technology (HIT) systems projects savings of around $30 billion per year.14 In one example, the VA-originated Blue Button web-based program allows patients to access their medical records, create portable medical histories, self-report health metrics, and view claims. Initiatives such as Blue Button are intended to facilitate information-sharing across platforms with providers, improve care coordination, and increase patient engagement.15

• Implementing a suite of Internet, mobile, and video tools at Kaiser Permanente Northern California (KPNC) revealed that operating as an integrated health care system improved information flow across patient care settings, administrative functions, and payment systems.16

• To overcome continuity problems and data loss caused by “dead-spots” in elevators, long corridors, and stairwells, health care facilities are investing in enterprise-wide mobility solutions for continuous wireless connectivity.17

• Connectivity is critical for mobile outreach programs (e.g., mobile emergency response programs) that need to capture data in real time and upload it to an EHR. For example, a mobile crisis team used a solution that integrated software with broadband connectivity to ensure devices were always connected and allowed data to be entered real-time into a patient’s EHR. This resulted in better care coordination and improved billing accuracy.17
Early mHealth models were primarily unsuccessful because of reimbursement issues rather than technological ones. Payment innovations were difficult due to the chronic nature of conditions, scope of care needed to address them, and mHealth management challenges. In addition, co-morbidity was often misunderstood or overlooked, understating the true savings that mHealth could bring. Value-based reforms that reward lower costs and better health outcomes may help advance the business case for mHealth.

- mHealth’s communication, coordination, monitoring, and data collection capabilities may provide tools to help achieve the goals inherent in new service delivery models such as accountable care organizations. These new delivery models and reimbursement reforms such as bundled payments are predicated on achieving quality outcomes against evidence-based standards. Payments are based on evaluations of clinical processes, patient experiences, outcomes, and efficiencies against industry benchmarks and base thresholds, including incorporating data flowing both remotely and at the point of care.

- Health care providers want to harness the power of mobile payments. Since providers collect between 35 percent and 65 percent of patient payments and 30 percent of provider revenues are derived from patient payments, smartphone-based systems offer an attractive payment option. A next-gen system might incorporate a self-service web portal that provides patients with access to their financial and clinical information and facilitates mobile payments.

A recent study found that four in 10 U.S. hospitals have adopted telehealth (a broadly defined category which incorporates mHealth). Factors influencing adoption included market features (highly competitive, rural rather than urban), complexity of services, and regulatory oversight such as payment and licensure restrictions.

• Regulations protecting the privacy and security of personal information, malpractice liability regulations, and little consistency between licensure and reimbursement laws across states and countries are barriers to extensive mHealth adoption.21, 22 A recent policy proposal seeks to provide guidance to state medical boards for regulating the use of telemedicine and to remove regulatory hurdles to widespread adoption of telemedicine technologies. These guidelines, in part, require that physicians validate the patient’s location and identity, disclose the provider’s identity, and obtain appropriate consent prior to providing telemedicine services. 23

mHealth technologies and permeable boundaries among existing and new entrants in the health ecosystem increase the complexity of managing PHI and compound an already challenging issue for industry stakeholders.

• Under the Health Insurance Portability and Accountability Act (HIPAA) Omnibus Rule (2013), health care organizations hold substantial responsibility for protecting PHI. This includes being prepared for the HIPAA audit program, where health care organizations can expect to be measured on, among other things, risk analysis procedures and safeguards to prevent data breaches.24

• Broad-based enterprise risk management policies should address government requirements such as HIPAA regulations and the Food and Drug Administration (FDA) guidance for managing cybersecurity in medical devices,25 as well as user trends such as “bring your own device” (BYOD).

• Consumer concern about the amount of personal information captured, stored, and shared by mobile devices is growing. A study found that 86 percent of consumers had taken steps to cover their digital footprints in 2013.26 The study also noted growth in consumers’ use of privacy tools that delete and block tracing cookies and encrypted messaging systems that block browsing and web search history.

As more advanced apps reach the mHealth market, either acting as medical devices or providing decision support, they will fall under increased regulatory scrutiny. In September 2013, the FDA adopted a risk-based approach to monitoring mobile medical apps and released guidance for a subset of apps considered to be medical devices that could potentially pose a threat to patient safety if their functionality failed (See page 10). The Food and Drug Administration Safety and Innovation Act (FDASIA) (2012) required the U.S. Department of Health and Human Services (HHS) to implement a strategy and recommendations for a risk-based framework for health IT, encompassing mHealth. In April 2014, HHS, in conjunction with three other federal agencies, outlined four key priority areas in the proposed strategy: promote the use of quality management principles; identify, develop, and adopt standards and best practices; leverage conformity assessment tools; and create an environment of learning and continual improvement. The proposed strategy and recommendations identify three categories of health IT functionality: 1) administrative functionality: no additional FDA oversight needed; 2) health management functionality: the FDA does not intend to focus on this area; 3) medical device functionality: FDA oversight and regulation needed.27
The U.S. FDA Guidance: Mobile Medical Applications

Guidance issued by the FDA in September 2013, suggested that the FDA considers the following to be mobile medical apps subject to regulatory oversight:

1. Mobile apps that are an extension of one or more medical devices by connecting to such device(s) for purpose of controlling the device(s) or displaying, storing, analyzing or transmitting patient-specific medical device data.

2. Mobile apps that transform the mobile platform into a regulated medical device by using attachments, display screens or sensors or by including functionalities similar to those of currently regulated medical devices. Such apps are required to comply with the device classification associated with the transformed platform.

3. Mobile apps that become a regulated medical device (software) by performing patient-specific analysis and providing patient-specific diagnosis or treatment recommendations. These types of apps are similar to or perform the same function as those types of software devices that have been previously cleared or approved.

Purpose: Disease dynamics
Fitness, wellness, care provision, disease management, and complex case management can be supported by mHealth functionality, but the approach has to fit the condition. While many conditions and treatment goals may lend themselves to mHealth, others may not. Certain diseases, particularly those with social stigma, may not, or may require a more nuanced approach.

- mHealth can support fitness and wellness activities and assist patients in managing certain health conditions, particularly chronic conditions such as diabetes, asthma, hypertension, and HIV/AIDS, and behavioral change programs which require regular management, such as smoking cessation and weight loss.28-31
- Wearable tech products with sophisticated algorithms that gather highly accurate health-related metrics are enabling patients to become more engaged and take a more active role in managing their health and wellness, and medical care.32-33 Wrist bands, jewelry, clothing, glasses, and embedded devices record data, support and encourage the wearer, and communicate data to others. Examples abound: health and fitness-related products such as Fitbit, Pebble Smartwatch, and Jawbone; personal devices that measure and track biometric details such as iHealth, Withings, or LifeSource wireless blood pressure monitors; and remote monitoring devices that combine advanced monitoring technology with personalized care management, such as Cardiocom’s vital sign measurement, and new technologies currently under development such as MC10 where sensors on the skin or within the body track vital statistics including heart rate, temperature, and brain activity; and digital medicines under development such as prescription medications with ingestible sensors such as those from Proteus Digital Health.

- To date, mHealth technologies have been instrumental in case management, providing a low-cost/high-touch base for pushing out information such as text-based medication or appointment reminders and sharing data with providers.34 Bundling a suite of mHealth services, including the capabilities to access their personal records and to manage their care, has been found to be successful in engaging patients in their own care and increasing access to providers in an integrated care organization (See page 12).
- Gamification, the use of gaming design to motivate and engage people in non-game contexts,35 forms the basis of many mHealth technologies. Scope ranges from general health improvement (diet and exercise) games that track progress via social networks to games designed around specific diseases. Motivational platforms such as Health Hero, Sonic Boom, and Keas use gamification, incentives, analytics, competition, and social networking to build a healthy community.
Kaiser Permanente Northern California’s (KPNC) flagship mobile and tablet applications allow members to exchange messages with their doctors, create appointments, view and refill prescriptions, and view their lab results and medical records. The smartphone app focuses on core transactional processes (self-service) while the tablet app focuses on prevention, health analytics, and achieving Kaiser Permanente’s “total health” vision. The apps are fully integrated with Kaiser’s electronic health record system.

KPNC mobile experience:

• One-fourth of the 34 million visits to KPNC’s website in the third quarter of 2013 were made to the mobile version of kp.org.

• By December 2013, 42,000 patients had used a mobile app that allows users to review test results, communicate with doctors, and schedule tests.

• 2.3 million telephone visits via mobile phone were anticipated to have been made by year-end 2013, compared to around 64,000 in 2008.

All data are from: Pearl. R., Kaiser Permanente Northern California: Current Experiences With Internet, Mobile, And Video Technologies. Health Affairs. 33, 2, 2014. pp:251-257
A fluid environment

Other dimensions of mHealth arise against the background of people, places, payment, and purpose. Mobile technologies’ functionality is applicable to a wide range of uses – from an individual’s chronic care management to complex population health analysis (Figure 5). As health care shifts towards a patient-centered and value-based delivery model, rapidly developing mHealth capabilities will likely enhance its role as a valuable partner in the transformation. Essential to the success of this partnership, of course, is the willingness of key stakeholders (consumers and providers) to embrace mHealth.

Other players in the mHealth market are emerging, each with unique opportunities and challenges. For example, telecommunications and medical device companies may have technologies to offer but should consider overcoming the hurdles of incorporating their products into existing health care business models. Others such as manufacturers and developers may create promising mHealth solutions but still need to gain clinical validation and regulatory approvals. And where does the mountain of data generated by mHealth ultimately reside? Who sets and maintains standards for ownership, safe storage, access, and the right to analyze the data? Viewing mHealth from a market perspective, clear roles and rules for many participants have yet to be defined. Developers, manufacturers, and network operators are looking to identify their place in the mHealth value-chain.
Figure 5: mHealth: from simple to complex

**Simple mHealth**
Focuses on a single purpose for a single user, typically consumer initiated.

- Smartphone apps and wearable tech products (wrist bands, jewelry, clothing, glasses, and embedded devices) that record data, support and encourage the wearer, and encourage the user, who may decide to communicate the data to others.
- Consumer driven, use of commercially available apps with a popular focus on wellness, diet, and exercise.
- Example: Fitness trackers and weight loss apps that provide tips and enable users to set goals and track weight, exercise, and calories.

**Social mHealth**
Draws upon the social capabilities of mobile technology including support, encouragement, or a sense of competition sourced through peer and social networks.

- Gamification and competition based apps; incentivization programs via financial, cash-equivalent or rewards-based incentives to encourage users to meet their goals.
- Consumers likely to pursue these activities on their own or via such vehicles as employment-based team challenges.
- Example: A fitness app that tracks an individual’s running statistics and shares results via a social network driven, goal-achievement challenge.

**Integrated mHealth**
Links apps and devices with the formal health care system, typically via an electronic health record (EHR). Exchanges data between a consumer and health care provider with real-time monitoring and care coordination.

- Mobile technology linking physician and patient (e.g., personalized and interactive administrative reminders such as appointments and prescriptions refill).
- Interfaces with organizations tailored to multiple end users – consumers, clinicians, and administrators.
- Example: Information from multiple apps that a patient uses is incorporated into the patient’s overall health record, giving a physician a more complete view of the patient.

**Complex mHealth**
Leverages advanced integrated analytics and provides decision support capabilities at the point of care.

- Deep and complex data generated through mHealth facilitates analysis and predictive analytics at the population level – whether focused on optimal management of a specific chronic condition through to risk-analysis and epidemic prediction or monitoring.
- Example: Data mining using algorithms to analyze data collected via mobile devices to deliver insights on an individual’s patterns of behavior for individual health management purposes. Data analysis oriented towards improving public health responses through analysis of sub-populations with different risk profiles and appropriate targeting of public health interventions.
Conclusion

New mHealth opportunities emerge every day: personalized health care, population health, diagnostics, and management of infectious diseases and global epidemics. The platform necessary to deliver mHealth already exists, and resides in users’ hands. What remains to be firmly established is proven evidence of mobile’s sustainable value to the health care industry. Combined with technology advancements, lessons learned as research findings and clinical experiences accumulate are expected to propel mHealth towards maturity. mHealth strategies are not “one-size-fits-all” and will likely take time to develop and refine. However, health care organizations should take note: Understanding and leveraging the four dimensions of effective mHealth – people, places, payment, and purpose – is a good place to start.
**Stakeholder considerations**

Health care organizations – providers, payers, and life sciences companies – should consider each of the four dimensions of mHealth as they weigh market entry.

**Health care providers**
- Introduce basic customer self-service options (e.g., appointment scheduling) for easy wins. Also, focus on conditions with an evidence base that supports using mobile technologies to diagnose, monitor, and treat patients. Initial choices might include non-acute conditions (minor injuries/wounds, routine follow-up), chronic disease states (diabetes, depression) and post-acute care (discharge management).
- Enlist physician and nursing leadership to champion mHealth, shift organizational culture, and update work flow systems. Incorporate mHealth technologies as “business as usual” in care management models to provide an alternative to face-to-face consultations. Resolve reimbursement issues with payment models (criteria, rates, outcomes) for virtual visits.
- Capture meaningful quality and cost indicators to enable economic analysis of the impact of programs such as clinical outreach and remote monitoring.

**Health plans/government payers**
- Bring payment for mHealth and virtual consultations into line with in-person consultations to stimulate investment in mHealth as a viable adjunct to bricks-and-mortar-based service delivery.
- Use levers such as provider incentives to promote mHealth capabilities and align with shifts in payment systems, quality improvement, and cost-saving initiatives.
- Partner with consumers to reduce mHealth’s risks and costs and to share its benefits. Align reward programs to motivate and reward consumers for certain behaviors or for being low-cost plan members. Similar to the safe driver rewards systems used in motor vehicle insurance, use mobile technologies to capture and report data on exercise or wellness accomplishments.

**Life sciences companies**
- Build better relationships with consumers through population health and medical compliance initiatives that are anchored by:
  - strategies that focus on communication channels such as social media
  - consumer relationship management
  - data analytics to identify customer preferences
- Understand how stakeholders (governments, health plans, providers, patients) define, determine, and value mHealth and how various global health systems approach the creation and regulation of mobile-enabled health care.
- Leverage gamification and approaches based on behavioral economics to increase adherence, brand awareness, and user preferences.
References


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