

Fall 2018

Mobile Health Applications: Background Research and Best Practices

Piper Cassidy

University of Southern Maine

Follow this and additional works at: https://digitalcommons.usm.maine.edu/muskie_capstones

Recommended Citation

Cassidy, Piper, "Mobile Health Applications: Background Research and Best Practices" (2018). *Muskie School Capstones*. 153.
https://digitalcommons.usm.maine.edu/muskie_capstones/153

This Capstone is brought to you for free and open access by the Student Scholarship at USM Digital Commons. It has been accepted for inclusion in Muskie School Capstones by an authorized administrator of USM Digital Commons. For more information, please contact jessica.c.hovey@maine.edu.

Mobile Health Applications:
Background Research and Best Practices

Piper Cassidy

Muskie School of Public Service

The University of Southern Maine

November 2018

Capstone Advisor: Judy Tupper, DHEd

Second Reader: Helena Ackerson, MPPM

MOBILE HEALTH APPLICATIONS

Table of Contents

Project Description	3
Background	3
Literature Review	4
Methods	8
Summary of U.S. News & World Report (USNWR) Hospital Apps	9
Recommendations	13
References	16
Figure 1- Types of Mobile Health Apps	20
Appendix A- Recommendations Handout	21
Appendix B. USNWR Honor Roll App Summaries	25
Table 1. USNWR 2018-2019 Best Hospitals Honor Roll	30
Table 2. USNWR Honor Roll Comparison Spreadsheet	31

MOBILE HEALTH APPLICATIONS

Project Description

This capstone was developed with the Patient Experience Department at Maine Medical Center (MMC) and an interdisciplinary MMC Tools and Technologies group. This research and analysis explores and outlines the foundations and best practices for mobile health (mHealth) applications (apps) across the spectrum of healthcare. mHealth apps used at some of the top rated hospitals in the country were selected and studied as possible templates for a similar initiative at MMC.

Background

MMC Bramhall is in process of a three phase, multi-year facilities master expansion. This \$512 million expansion will include additions to the existing visitors parking garage and patient tower, conversion of double-occupancy rooms to single-occupancy, and construction of twenty new operating rooms, a new employee parking garage, and a new main entrance (Maine Health, 2018). The Patient Experience Department understands that the facilities upgrade will help expand and modernize the ability of the physical space to serve the community, and in conjunction with that upgrade, the development of a mobile app presence would offer an additional layer of support to those seeking care at MMC.

Pew Research Center (2018) reports that seventy-seven percent of Americans use a smartphone. Of that seventy-seven percent, seventy-three percent are ages 50-64 and forty-six percent are 65 and older. Given the steady increase in smartphone use across all ages, developing a smartphone app presence to support patients both now and in the future may offer more robust patient access and support, in keeping with the patient-centered focus of current government and private sector initiatives.

MOBILE HEALTH APPLICATIONS

Mobile health apps are health-based applications that patients can download to their smartphones, tablets, or computers. These apps can be used by patients alone or in partnership with their health care team. Currently, MMC uses MyChart and a pharmacy app used for refilling prescriptions. This capstone provides a base of research on mobile health app literature and best practices, as well as an exploration of processes around new technology development and integration with patient experience.

Literature Review

Types of Mobile Health Applications

There are many different types of apps that can meet the varying needs of hospitals. Mobile health apps fall into two main categories. They can provide either general information, or serve as electronic personal health records (PHR). General information apps are used to provide facility or organization information and do not require a login. Emergency room and urgent care wait time apps, wayfinding apps, and facility information apps that include hours of operation, directories, etc. are all examples of general information apps.

PHRs can be divided further into the categories of tethered or untethered (stand-alone). Tethered PHR are commonly referred to as patient portals, and are connected to the institutional electronic medical record (EMR). Examples of tethered PHRs include outpatient apps, physician referral apps, MyChart (the patient portal offered at healthcare organizations using the Epic interface), and other independently designed organization-specific portal apps.

Untethered, or stand-alone, apps are not linked to any EMR. These apps can be used to track medical information, but only information that is entered by the user. Untethered apps include *wellness management apps* such as Health (standard on all iPhones), medication trackers, fitness trackers (Fitbit, Apple Watch), and *condition-specific or disease-management apps* used

MOBILE HEALTH APPLICATIONS

for diverse purposes such as tracking ovulation or monitoring the varying factors of diabetes control. *Rehabilitation apps* can be a hybrid of wellness and disease management, with systems for providers to outline rehabilitation programs and systems for patients to track their progress and record results for their program. (Aiello, 2013; Lambert, n.d.; Kao & Liebovitz, 2017; McAlearney et al., 2016)

A visual summary of the different app types can be found on page 20 under Figure 1:
Types of mHealth Apps.

Benefits

One of the most impactful and far-reaching benefits of mHealth is the encouragement of patients to participate in the management of their health and healthcare. mHealth can be used as a secondary source of information and support. There has been a gradual shift away from the traditional health care model and patients have moved from a passive role to a more active role (Meskó, Drobni, Bényei, Gergely, & Györffy, 2017). The use of mHealth is one way that patients can be proactive with both their own health and the ways they interact with their healthcare system. (Mendiola, Kalnicki, & Lindenauer, 2015)

The health belief model is a framework for understanding behavior change based on an individual's perceptions of severity and susceptibility combined with the perceived benefits and barriers to making a health change (Carpenter, 2010). The health belief model offers a behavior change theory that may justify the introduction of mHealth during a critical time in a patient's life with the goal of developing their relationship with health information technology. Engaging people with apps during a hospital stay may have a positive long term effect on their healthcare as the impetus to actively engage in care through an app. During a hospital stay, a patient's

MOBILE HEALTH APPLICATIONS

perceptions of severity and susceptibility of illness are heightened, and they may be more willing to engage in efforts to improve their health long-term. (McAlearney et al., 2016)

The shift from professional-controlled to professional-managed healthcare is a major benefit of mHealth in its many forms, but it is not the only benefit. Improving outcomes, increasing patient knowledge and comfort, saving time and money, and increasing communication are all potential benefits of mHealth.

The evidence concerning the direct impact of mHealth on health outcomes is small but expanding. Some studies have shown a positive influence on patients' health through use of a mobile app, while others see no influence or are inconclusive (Rathbone & Prescott, 2017). The Mayo Clinic reports improvements in patients with heart disease using a rehabilitation app after cardiac procedures (Klein, 2014). While this study is small, it suggests a possible role for apps to decrease readmissions and improve outcomes. As the body of evidence-based literature expands, so will the opportunity to identify the aspects of mHealth that impact behavior change, leading to better, more effective mHealth design (Kao & Liebovitz, 2017).

Mobile health apps have been shown to increase patient knowledge of a topic and support improved patient-provider communication; their use adds an important tool to the field of shared decision making in health care (Rahimi, Menear, Robitaille, & Légaré, 2017). Patients may engage more fully in conversations about their health when they are equipped with high quality information; mHealth apps have been shown to empower patients and result in high satisfaction with the patient-provider interaction.

Cost reduction is often a priority for any major undertaking at an organization, and developing an mHealth presence is no exception. Improved health outcomes through mHealth usage may lower healthcare costs for the patients and healthcare organizations and long-term

MOBILE HEALTH APPLICATIONS

population health improvement is one way that mHealth can save money. Decreasing healthcare utilization, time and personnel used to assist with tasks such as wayfinding are additional ways that mHealth can reduce costs. An emergency department (ED) app that communicates real time wait times and can help direct qualified patients to urgent care may save money from unnecessary ED usage. An interaction between a patient and provider online instead of a face-to-face appointment saves time and money. Missed appointments are estimated to cost the U.S. healthcare system \$150B every year, and an automated appointment reminder can save the cost of a missed appointment for both the patient and provider (Gier, 2017).

Barriers to App Development & Implementation

Developing and implementing an app, or series of apps, introduces some challenges. App development can be expensive, and there are additional financial considerations including, but not limited to, public relations, advertising, printed and online education materials, and training.

Health literacy is a significant consideration for patients of all demographics with regard to the uptake of health-related apps, particularly among older adults and those of low socioeconomic status. These populations tend to have higher rates of chronic disease and co-morbidities, and therefore warrant special consideration when designing and implementing mHealth (McAlearney et al., 2016). Partnering with patients during the design and testing of new apps is an important step toward addressing health literacy needs for all users of mHealth apps (Rahimi et al., 2017).

Privacy and security are concerns for both patients and healthcare systems due to the sensitive nature of the data involved in mHealth. Patients may be hesitant or unwilling to engage with mHealth out of concern for protecting their personal information (Abelson et al., 2017). Data can be unsecure at the level of software and technology, and security can also suffer due to

MOBILE HEALTH APPLICATIONS

the number of people involved with any one patient or healthcare event. When developing mHealth technology, an organization must ensure data is kept private and secure. Involving all stakeholders, from patients to policy developers, can help fill in possible gaps in the privacy and security of an mHealth app (Bhuyan, et al., 2017).

Mobile health is variable in nature and a fairly new concept, and because of this it comes with limited regulation and quality control. The lack of verified benchmarks for quality, safety and excellence can make it hard for both healthcare systems and patients to know whether mHealth is safe and effective (Van Velthoven, Smith, Wells, & Brindley, 2018). The Food and Drug Administration (FDA) does regulate mHealth apps to a certain degree, but only the apps that are classified as “medical devices” and considered to be a moderate or high risk to the public. Those regulated by the FDA include devices and apps that interpret health data for a patient, such a reading blood glucose (Food and Drug Administration, 2018).

Methods

An application for this capstone to the University of Southern Maine’s Internal Review Board was submitted on July 1, 2018. Exemption was granted on July 3, 2018, as this project is not research involving human subjects.

Literature Review

Conducting a thorough literature review is a central activity of this capstone. Mobile health is a field that changes at the speed of technology, and what was reported in the literature five years ago might not be relevant today because the technology involved is no longer the industry standard. It can be a challenge to develop a base of knowledge in a field that changes as quickly as mobile health, so identifying a basic, but flexible, set of best practices is important.

MOBILE HEALTH APPLICATIONS

The literature review was conducted using available databases within the University of Southern Maine library system. The majority of searches were refined for scholarly and peer-reviewed articles published within approximately the last five years. Grey literature was also examined due to the practice-based nature of mHealth.

Tools & Technologies Group

In conjunction with the literature review, this author attended monthly meetings of MMC's Tools and Technologies group. This group is headed by the Patient Experience Department, and includes project managers, representatives from MMC's information technology (IT) department, and the CEO of NavigatER, LLC. These meetings included calls with those involved with the technological upgrades happening during the master facility upgrade, as well as presentations from NavigatER LLC. This group provided context for the flow and procedure of developing and implementing mHealth within a healthcare system. Important topics ranging from IT logistics to the legal side of mHealth development were discussed, and these meetings provided an important perspective of mHealth within an organization.

Summary of U.S. News & World Report (USNWR) Hospital Apps

Every year U.S. News & World Report (USNWR) releases a report ranking the best hospitals in the U.S. in 16 areas of specialty care, such as cardiology, diabetes, and geriatrics. These specialty rankings, combined with high-complexity specialty inpatient care outcomes and ratings of safety, efficiency, and other quality indicators, produce their annual "Best Hospital Honor Roll" (Comarow & Harder, 2018). See Table 1. USNWR 2018-2019 Best Hospitals Honor Roll on page 30.

There are multiple entities that rank hospital differently, and the USNWR is just one report that patients can reference when seeking specialty care, but the USNWR Honor Roll can

MOBILE HEALTH APPLICATIONS

be seen as a benchmark in the industry for excellence and innovation. For this reason, it was chosen as the reference point for app usage in hospitals today. The top two health systems, Mayo Clinic and Cleveland Clinic, were selected to obtain a snapshot of how top-ranked hospitals are using mHealth. The remaining three, UCSF Medical Center, Stanford Health Care, and Brigham & Women's Hospital, were chosen for their similar numbers of inpatient beds to Maine Medical Center's 637 beds. All twenty hospitals on the honor roll are very different from MMC, as MMC is unique in both infrastructure and the population it serves. This author and the second reader agreed to use the number of inpatients beds as a metric for comparison.

Common App Features

The five health system apps reviewed are very different in many ways, however there are common features throughout all five. Some secondary wellness apps are available for a fee, such as Mayo Clinic's "AnxietyCoach" app. The main portal apps for all five systems are free to download, removing the potential barrier of cost affecting a patient's ability and desire to download the app. The majority of additional apps offered by each health system are free of charge.

MyHealth from Stanford Health Care was developed internally, as was the Mayo Clinic app. Brigham & Women's Hospital offers a portal developed by Partners Healthcare System, Inc., which provides portal access to eleven member hospitals and one affiliate institute. UCSF Medical Center and Cleveland Clinic utilize Epic's MyChart as their primary portal app. UCSF Medical Center is currently in the process of developing web and mobile-based engagement platforms in collaboration with Dignity Health. Cleveland Clinic offers eleven secondary apps developed internally by Cleveland Clinic Innovations.

MOBILE HEALTH APPLICATIONS

All systems offer their applications across iOS and Android operating systems. MyChart and Mayo Clinic are also available on Apple Watch. Mayo Clinic and Brigham and Women's apps are available in limited languages, while Stanford's MyHealth is available in six languages. MyChart is available in nine languages, making it the most diverse of the apps reviewed in this capstone.

Available features are similar across all five apps. With few variations, each offers:

- Appointment scheduling and management, some included check-in
- Secure provider messaging
- Lab and radiology results, some with additional clinician notes
- Bill pay

Several apps also include variations on the ability to view past medical history, prescription and medication information, immunizations, and other similar information.

Several apps offer elements unique to their institutions that highlight the ways in which mHealth can help decrease costs, time, and stress for patients while still being able to receive quality care. For example, Mayo Clinic offers Express Care Online in some regions. Registered patients are able to fill out a questionnaire for one of 14 conditions and receive a response from a provider within an hour, and any needed prescriptions are sent to a pharmacy. The patient's provider has access to the medical record from the 'online visit' and Mayo views this 'visit' as part of the care a patient receives, not as a service outside of it. The cost of Express Care Online is \$49 per visit, and some or all of the cost may be covered by insurance (Mayo Clinic Express Care Online, 2017).

Stanford Health Care identified a patient population within their accountable care organization that did not use primary care but were generally healthy and used urgent/emergent

MOBILE HEALTH APPLICATIONS

care when needed. Stanford developed a program called Clickwell Care in response to this population. Clickwell Care focuses on the use of virtual primary care for patients ages 18 to 40. Clickwell Care is a combination of primary care and health coaching available in a traditional clinic setting with extended hours and appointments available via telephone and video with the goal of providing care to a patient population that struggled with the traditional primary care model. Data from 2015 showed 60% of clinic were virtual encounters (Srinivasan, 2016).

Stanford Health Care is also one of the healthcare systems that participated in Apple's Healthkit, launched in 2015. Healthkit is a tool that allows health data to be transferred from a user to a provider. Stanford piloted Healthkit with pediatric patients who have diabetes, allowing implanted glucose readers to transmit blood sugar readings via Bluetooth to a device, which then uploads to a medical record, giving providers real time data. This fast and continuous update means that problems can be spotted more quickly, and appointments are more efficient, as patients can skip the step of updating providers with the most recent numbers (Finz, 2015).

Mobile health innovation is not always delivered through a smartphone or tablet. Brigham and Women's Hospital in Boston has developed a web-based wayfinding program that provides patients with directions from wherever they are, even if they are already on campus, to their next location with printable, turn-by-turn directions. The user-friendly design uses simple language and logic to design easy-to-follow directions that offer customizations like picking valet or self-parking close to the desired location (Brigham and Women's Hospital Maps, n.d.).

Table 2 on page 31 provides a USNWR Honor Roll Comparison Spreadsheet for key information about mHealth apps at the five selected systems. A more detailed outline of the

MOBILE HEALTH APPLICATIONS

mHealth presence at each hospital can be found in Appendix B. USNWR Honor Roll App Summaries on page 25.

Recommendations

Multi-Platform Approach

Introducing an app at an organization can be an enormous undertaking as well as a considerable adjustment to patients, providers, and employees. Learning curves and logistical challenges are inevitable and rolling out new technology at a pace that works best for everyone involved is an important element to the success of any mHealth undertaking. That said, addressing the many needs of different populations that interact with MMC will likely require the development and adoption of more than one app and may need to be approached on more than one platform. An app that is one-stop access for inpatients, outpatients, family, and visitors would be ideal, but could be complex and challenging, both for developers and the patient population. Multiple apps that reflect changes in patient status across the continuum of care may yield better results. Starting health and technology education at the beginning of a hospital stay, rather than at discharge, gives patients more time to ask questions and get comfortable with the technology before they return home. Similar and overlapping formats from inpatient to outpatient will encourage continuation of app usage (McAlearney et al., 2016).

A multi-platform wayfinding solution may be the best way to address wayfinding challenges for the broad spectrum of people traveling to and within MMC. While smartphone usage is always increasing, some of Maine's population may still rely on desktop computers for their information needs. The development of a webpage exclusively dedicated to wayfinding, in conjunction with either a mobile wayfinding app, or the inclusion of wayfinding as part of a primary app, will have a greater reach into MMC's older and more rural populations.

MOBILE HEALTH APPLICATIONS

Design and Implementation

Designing an app that people can and will use starts with a thoughtful approach to how and why people use apps. Self-determination theory (SDT) is a concept of behavior change that focuses on a person's internal motivation as the source of that change (Ryan & Deci, 2000). Mendiola, Kalnicki, & Lindenaue (2015) recommend using SDT when approaching app design. App usage will be self-motivated, and design should promote the three psychological needs at the base of SDT: competence, autonomy, and relatedness. Users need to feel competent when using the app, and may discontinue use if they get frustrated. Users need to have control over when and how they use the app to promote autonomy. Users may want to join an online community or interact with others through the app to fulfill the need to relate to others.

Usability, simplicity, intuitiveness, and easy interface are all elements of mHealth design that can promote usage (Mendiola, Kalnicki, & Lindenauer, 2015). A high-usability design should go hand-in-hand with a health literacy-friendly design. The product should not only be intuitive in its visual and interface design, but the content design should include all potential users, especially those with low health literacy (Hemsley, Rollo, Georgiou, Balandin, & Hill, 2017). Davis, Osborn, Kripallani, Goggins, and Jackson (2015) found low health literacy and education affected portal registration and health record access rates during hospitalization. This research also found that health literacy had an impact on important aspects of portal usage, including appointment management and education tools. Any developed mHealth app should be offered in a variety of languages, focusing on those most common to MMCs patient population.

A strong training and support plan is crucial to the successful launch and implementation of a new app (Coughlin, Stewart, Young, Heboyan, & De Leo, 2018; McAlearney et al., 2016). Training, as well as design, should also take into account those who support patients, be they

MOBILE HEALTH APPLICATIONS

family, support workers, or caregivers. App usage may be higher if family members and others in the realm of social influence are supportive. For older adults and those with disabilities, the training of their caregivers can be the bridge to helping them experience the benefits offered by mHealth (Coughlin, et al., 2018; Hemsley et al., 2017).

Provider involvement plays an important role in the implementation and adoption of app usage. Kao and Liebovitz (2017) identify a term called “app prescription” as a future recommendation for mHealth utilization. App prescription elevates an app recommendation from a casual suggestion to an active part of the care plan or treatment, and some evidence has shown provider involvement having a positive relationship with longevity in app usage. Providers as partners in development and implementation, can foster trust in the product and a sense of shared partnership in use of mHealth (Meskó, Drobni, Bényei, Gergely, & Györffy, 2017)

Despite some of the obstacles and challenges a healthcare organization may face in developing, designing, and implementing an mHealth presence, in 2018 there is overwhelming potential for mHealth to have a beneficial role. Mobile health can address gaps and failures in the system for patients and save time, money, and resources for the health system and its employees. If designed with our most vulnerable populations in mind, and based in the science of behavior change, mHealth offers the potential to engage patients and improve health outcomes.

MOBILE HEALTH APPLICATIONS

References

- Abelson, J. S., Kaufman, E., Symer, M., Peters, A., Charlson, M., & Yeo, H. (2017). Barriers and benefits to using mobile health technology after operation: A qualitative study. *Surgery, 163*(3), 605-611. doi: <https://doi.org/10.1016/j.surg.2017.05.007>
- Aiello, M. (2013, February 27). 4 top mobile app types for healthcare providers. *HealthLeaders*. Retrieved from: <https://www.healthleadersmedia.com/strategy/4-top-mobile-app-types-healthcare-providers>
- Bhuyan, S.S., Kim, H., Isehunwa, O. O., Kumar, N., Bhatt, J., Wyant, D. K.,...Dasgupta, D. (2017). Privacy and security issues in mobile health: Current research and future directions. *Health Policy and Technology, 6*(2), 188-191. doi: <https://doi.org/10.1016/j.hlpt.2017.01.004>
- Brigham and Women's Hospital Maps. (n.d.). Retrieved from: <https://maps.brighamandwomens.org/>
- Carpenter, C.J. (2010). A meta-analysis of the effectiveness of health belief model variables in predicting behavior. *Health Communication, 2*(8), 661-669. doi: <https://doi.org/10.1080/10410236.2010.521906>
- Comarow, A., & Harder, B. (2018, August 14). 2018-19 Best hospitals honor roll and medical specialties rankings. *U.S. News & World Report*. Retrieved from: <https://health.usnews.com/health-care/best-hospitals/articles/best-hospitals-honor-roll-and-overview>
- Coughlin, S. S., Stewart, J. L., Young, L., Heboyan, V., & De Leo, G. (2018). Health literacy and patient web portals. *International Journal of Medical Informatics, 113*, 43-48. doi: <https://doi.org/10.1016/j.ijmedinf.2018.02.009>

MOBILE HEALTH APPLICATIONS

- Davis, S. E., Osborn, C. Y., Kripalani, S., Goggins, K. M., & Jackson, G. P. (2015). Health literacy, education levels, and patient portal usage during hospitalizations. *AMIA Annual Symposium Proceedings*, 1871–1880.
- Finz, S. (2015, November 13). Using Apple Healthkit to care for patients with Type 1 diabetes. Retrieved from: <https://med.stanford.edu/news/all-news/2015/11/using-apple-healthkit-to-care-for-patients-with-type-1-diabetes.html>
- Food and Drug Administration. (2018, October 8). *Mobile medical applications*. Retrieved from: <https://www.fda.gov/medicaldevices/digitalhealth/mobilemedicalapplications/default.htm#b>
- Gier, J. (2017, April 26). *Missed appointments cost the U.S. healthcare system \$150B each year*. Retrieved from: <https://www.healthmgtech.com/missed-appointments-cost-u.s.healthcare-system-150b-year>
- Hemsley, B., Rollo, M., Georgiou, A., Balandin, S., & Hill, S. (2017). The health literacy demands of electronic personal health records (e-PHRs): An integrative review to inform future inclusive research. *Elsevier*, 101(1), 2-15. doi: <https://doi.org/10.1016/j.pec.2017.07.010>
- Kao, C., & Liebovitz, D. M. (2017). Consumer mobile health apps: Current state, barriers, and future directions. *Elsevier*, 9(5), S106-S115. doi: <https://doi.org/10.1016/j.pmrj.2017.02.018>
- Klein, T. (2014, March 29). *Mayo research shows cardiac rehab patients who use smartphone app recover better*. Retrieved from: <https://newsnetwork.mayoclinic.org/discussion/cardiac-rehab-patients-who-use-smartphone-app-recover-better-mayo-clinic-research-shows/>

MOBILE HEALTH APPLICATIONS

Lambert, J. (n.d.) 8 types of mobile hospital apps and the 3 features patients want most.

Merraine Group Inc. Retrieved from: <https://www.merraine.com/8-types-mobile-hospital-apps-3-features-patients-want/>

Maine Health. (2018, March 27). *MMC receives final approval to begin construction on phase I of its modernization and expansion* [Press release]. Retrieved from:

<https://mainehealth.org/news/2018/03/mmc-receives-final-approval-to-begin-construction-on-phase-i-of-its-modernization-and-expansion>

Mayo Clinic Express Care Online. (2017, Spring). *WellMe Newsletter*. Received from:

https://www.healthservicestobusiness.com/wellme_article/mayo-clinic-express-care-online/

McAlearney, A. S., Sieck, C. J., Hefner, J. L., Aldrich, A. M., Walker, D. M., Rizer, M. K.,...

Huerta, T.R. (2016). High touch and high tech (HT2) proposal: Transforming patient engagement throughout the continuum of care by engaging patients with portal technology at the bedside. *JMIR Research Protocols*, 5(4), e221.

doi: 10.2196/resprot.6355

Mendiola, M. F., Kalnicki, M., & Lindenauer, S. (2015). Valuable features in mobile health apps

for patients and consumers: Content analysis of apps and user ratings. *JMIR Mhealth and Uhealth*, 3(2), e40. doi: 10.2196/mhealth.4283

Meskó, B., Drobni, Z., Bényei, É., Gergely, B., & Györfy, Z. (2017). Digital health is a cultural transformation of traditional healthcare. *mHealth*, 3, 38. doi:

10.21037/mhealth.2017.08.07

MOBILE HEALTH APPLICATIONS

Nicholaou, L. (2016, May 15). The Mayo Clinic app, what every patient app should be.

Medium. Retrieved from: <https://medium.com/@libbyn/the-mayo-clinic-app-holds-the-gold-standard-for-mobile-patient-services-a95fdab064ba>

Pew Research Center. (2018, February 5). *Mobile Fact Sheet* [Fact Sheet]. Retrieved from:

<http://www.pewinternet.org/fact-sheet/mobile/>

Rahimi, S., Menear, M., Robitaille, H., & Légaré, F. (2017). Are mobile health applications useful for supporting shared decision making in diagnostic and treatment decisions? *Global Health Action, 10*. doi: 10.1080/16549716.2017.1332259

Rathbone, A.L. & Prescott, J. (2017). The use of mobile apps and SMS messaging as physical and mental health interventions: Systematic Review. *JMIR Publications, 19*(8), e295. doi: 10.2196/jmir.7740

Ryan, R.M. & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*(1), 68-78. doi: <http://dx.doi.org.ursus-proxy-1.ursus.maine.edu/10.1037/0003-066X.55.1.68>

Srinivasan, V. (2016, March 9). How Stanford achieved 60% telehealth adoption at a primary care clinic. *The Growth Channel*. Retrieved from:

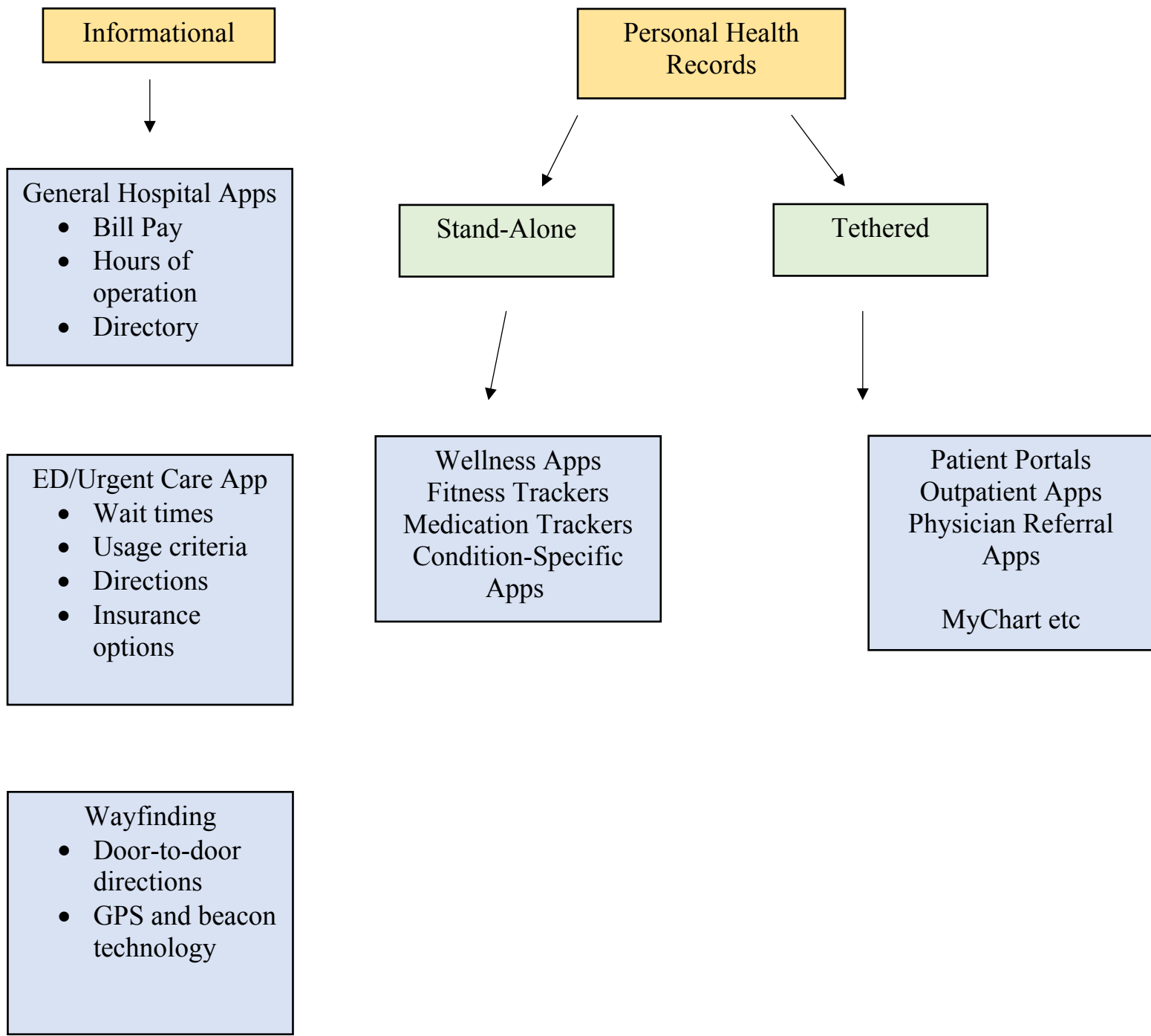
<https://www.advisory.com/research/market-innovation-center/the-growth-channel/2016/03/stanford-medicine-virtual-visits>

Van Velthoven, M.H., Smith, J., Wells, G., Brindley, D. (2018) Digital health app development standards: a systematic review protocol. *BMJ Open, 8*(8), e022969.

doi: 10.1136/bmjopen-2018-022969

MOBILE HEALTH APPLICATIONS

Figure 1: Types of mHealth Apps



MOBILE HEALTH APPLICATIONS

Appendix A. Recommendations for Implementing Mobile Health*Developed for Maine Medical Center*

Development & Design

Partner with patients

Involving patients from the beginning will increase the opportunities to meet patients' needs and expectations. A variety of patient stakeholders should be involved in design, to better capture the needs of primary mHealth users. (Rahimi et al., 2017)

Universal Design

Patients value apps that are easy to use, simple in design, and intuitive. Include a variety of language options. (Mendiola, Kalnicki, & Lindenauer, 2015)

Health literacy

Testing content for literacy-friendly language and design as well as building in literacy assessments and getting user feedback on simplicity of content will make mHealth more accessible to all. (Coughlin et al., 2018) (Hemsley, Rollo, Georgiou, Balandin, & Hill, 2017) (Davis, Osborn, Kripallani, Goggins, and Jackson, 2015)

Offer a multitude of platforms

Offering an mHealth app on all iOS and Android platforms, including Apple Watch, increases not only how many people can interact with the app, but the number of modern technological advances that can be utilized. (Pew Research Center, 2018)

Consider developing a wayfinding app at the same time

While developing a primary portal app, consider developing either a stand-alone wayfinding app, a stand-alone web-based wayfinding site, or building a wayfinding program into the primary app. Wayfinding should be a priority for a busy healthcare system.

MOBILE HEALTH APPLICATIONS

Easy-interface design

When apps do not interface with other software in an organization, patients may get frustrated and lose confidence and interest in using the app. Interface between programs and software is of high value to users (Mendiola, Kalnicki, & Lindenauer, 2015)

Similar visuals and concepts across different apps

All apps and platforms supported by an organization should look and behave similarly. This is a method of “branding” an organization, and also makes content users are comfortable with.

Familiar and modern technology

Users will look for common features such as Touch ID and Face ID when accessing and using their apps, and may get frustrated if the app does not offer it. (Nicholaou, 2016)

Key features

Offer key features commonly found in mHealth portal apps such as appointment scheduling, provider messaging, viewing lab and test results, and bill pay.

Privacy and security

Prioritize privacy and security during the development of any mHealth product. Involve key stakeholders when developing security protocols and keep security and privacy software up to date with current technologies and policies. (Bhuyan et al., 2017)

Before Implementation

Training

Employee, patients, family & caregivers should all be considered when designing and implementing a training plan. The more people who receive training, the more resources users have when using mHealth. (Coughlin, Stewart, Young, Heboyan, & De Leo, 2018; McAlearney et al., 2016)

MOBILE HEALTH APPLICATIONS

Promotion of existing apps to increase comfort

It may take time, even years, to develop a primary portal app. Encouraging the use of MyChart now will ease the transition when a new app is developed, and will be helpful if MyChart is part of the newly developed app.

During Implementation

Extra support during rollout

Having extra people available in person and on the phone to help users navigating the app for the first time can ease transition and encourage adoption. Having employees trained to the app will help during this stage as well.

Provider buy-in

Patients look to providers for recommendations, and put their trust in mHealth being recommended by a medical professional. Having providers, including nursing, supportive and encouraging of a mHealth app will encourage adoption.

(Meskó, Drobni, Bényei, Gergely, & Györfy, 2017)

Continued Usage

App Prescription

Having providers implement mHealth into their recommendations, or “prescriptions”, can increase adoption and continued use. This may be especially beneficial for any education apps that are developed. (Kao and Liebovitz, 2017)

Continuous loop of feedback and improvement

MOBILE HEALTH APPLICATIONS

Building in a mechanism to encourage and ease user feedback will promote a continuous improvement process for any mHealth apps that are developed. Mobile technology should be viewed always growing and changing, never finished.

Continued promotion

Providers and employees may become complacent and take the usage of app for granted, or assume that patients and visitors already know about it. Employees should continue to promote and encourage use of the app over months and years.

Development of new apps

Identify problem areas using feedback and use that information to not only improve current mHealth apps, but develop new apps and technologies.

Gather metrics

Mobile health apps are an excellent opportunity to gather metrics on trends in usage and populations, but always with privacy and security in mind.

MOBILE HEALTH APPLICATIONS

Appendix B. USNWR Honor Roll App Summaries**Mayo Clinic- #1****Rochester, MN**

- 794-bed Mayo Clinic Hospital, Methodist Campus
- 1,265-bed Mayo Clinic Hospital, Saint Mary's Campus
- 148-bed Mayo Eugenio Litta Children's Hospital (part of the Saint Mary's Campus)

Primary portal app: Mayo Clinic

Cost: Free

Developer: Mayo Clinic

Platforms: iPad, Apple Watch, iPhone, iPos Touch, Android

Available languages: English

Features:

Appointment management/scheduling

Secure provider communication

Lab results, test results, clinical notes

News, nutrition, wellness advice

Bill pay

Express Care Online- Offers patients the ability to receive treatment for 14 common diagnoses via questionnaire without seeing a provider in-person (costs \$49).

Other Hospital Apps:

Mayo Clinic for Medical Professionals- Free, ContrastTx- Free

AnxietyCoach- \$4.99

Websites for reference:

<https://medium.com/@libbyn/the-mayo-clinic-app-holds-the-gold-standard-for-mobile-patient-services-a95fdab064ba>

<https://www.mayoclinic.org/patient-visitor-guide/minnesota/clinic-hospital-buildings>

<https://mayoclinichealthsystem.org/express-care-online>

App-<https://www.mayoclinic.org/apps/mayo-clinic>

MOBILE HEALTH APPLICATIONS

Cleveland Clinic-#2

Cleveland, OH

1,400 beds on Cleveland Clinic main campus and 4,538 beds system-wide

Primary portal app: Cleveland Clinic Today (MyChart is embedded into the app)

Cost: Free

Developer: Cleveland Clinic Innovations (Epic)

Platforms: iPhone, iPad, iPod Touch, Android, Apple Watch

Available languages: English, Arabic, Danish, Dutch, Finnish, French, German, Spanish, Swedish

MyChart Features:

Review test results, medications, immunization history

Stay in touch with your physician

Upload health and fitness data, including data from the Apple Health app, when enrolled in self-tracking programs

View and pay your bill

Access your family's health information

Cleveland Clinic Today features:

Find a doctor

Locations & Directions

Manage your appointments

Contact Us

Express Care Online- Similar to Mayo Clinic's Express Care Online, Cleveland Clinic's Express Care offers video appointments with providers for minor, non emergent care.

- | | |
|---|--|
| <ul style="list-style-type: none"> • Cleveland Clinic Today • Cleveland Clinic CME • DDSI Instant Opinion and Referral • Wellness Tip of the Day • Cancer Trials • GO! TO SLEEP® • Stress Free Now | <ul style="list-style-type: none"> • Stress Free Now Healer's Version • Health Q&A • Healthy Brains • MyEpilepsy • Sideline Guidelines • ORAnywhere • Heart Story |
|---|--|

Websites for reference:

<https://my.clevelandclinic.org/about/overview/who-we-are/facts-figures>

<https://my.clevelandclinic.org/online-services/express-care-online>

MOBILE HEALTH APPLICATIONS

<https://my.clevelandclinic.org/mobile-apps>

MOBILE HEALTH APPLICATIONS

UCSF Medical Center-#5**San Francisco, CA**

796 Beds

Primary portal app: MyChart

Cost: Free

Developer: Epic

Platforms: iPhone, iPad, iPod Touch, Android, Apple Watch

Available languages: English, Arabic, Danish, Dutch, Finnish, French, German, Spanish, Swedish

Features:

Review test results, medications, immunization history, and more

Secure provider communication

- Manage appointments
- Upload health and fitness data, including data from the Apple Health app, when enrolled in self-tracking programs
- View and pay your bill
- Access your family's health information

Other hospital apps:

UCSF Center for Joint Replacement

Developer: Care for Patients

UCSF Medical Center is currently in the process of collaborating with Dignity Health to develop a web and mobile based engagement platform.

Websites for reference:

<https://www.ucsf.edu/news/2018/07/411136/ucsf-use-dignity-health-digital-platform-increase-health-access>

<https://www.ucsfhealth.org/ucsfmychart/>

MOBILE HEALTH APPLICATIONS

Brigham & Women's Hospital-#20

Boston, MA

777 Bed Teaching hospital of Harvard Medical School

Primary portal App:

Partner's Patient Gateway -11 member hospitals and 1 affiliate institute (also used by Mass General, #4 on the Honor Roll)

Cost: free

Developer: Partners Healthcare System, Inc.

Platforms: iPhone, iPad, iPod touch, Android

Available languages: English and Spanish

Features:

Appointment management/scheduling

Test results

Secure provider communication

Prescription renewal

Bill pay

Other Features:

Web-based Wayfinding tool

<https://maps.brighamandwomens.org/>

Door-to door directions including parking preferences

Brigham Health Inc. Apps:

Brigham IBD Circle- Crohns and Colitis symptom diary

Brigham RA Research/BWH RA Flare- Symptom tracking and direct provider download

Brigham Asthma Research/BWH Asthma- symptom tracker and direct provider download as part of a research study

Websites for reference:

<https://www.bwhihub.org/apps/>

<https://maps.brighamandwomens.org/>

<https://patientgateway.partners.org/login/>

MOBILE HEALTH APPLICATIONS

Stanford Health Care- Stanford Hospital-#9

Stanford, CA

613 bed hospital

Primary portal app: MyHealth

Website: <https://myhealth.stanfordhealthcare.org/#/>

Developer: Stanford Health Care

Cost: Free

Platforms: iPhone, iPad, iPod Touch, Android

Available languages: English, Danish, Dutch, French, German, Spanish

Features:

Appointment scheduling

Appointment check-in

Test results

Secure provider communication

Virtual appointments- Clickwell Care clinic

Manage prescriptions and medications

Health summaries

Bill pay

Share vitals with provider- Healthkit integration (requires provider authorization)

Other available apps:

Stanford Children's Health

HealthySteps Benefits (for employees)-Lucile Packard Children's Hospital

Other features:

Website: 24/7 phone and live chat assistance

Online second opinion program

Directions directly to parking

Websites for reference:

<https://med.stanford.edu/news/all-news/2015/11/using-apple-healthkit-to-care-for-patients-with-type-1-diabetes.html><https://stanfordhealthcare.org/><https://www.zdnet.com/article/apple-health-and-apple-healthkit-what-you-need-to-know/><https://www.healthcare-informatics.com/article/patient-engagement/it-leaders-shares-how-stanford-health-care-transforming-patients-digital><https://scopeblog.stanford.edu/2016/02/22/clickwell-care-an-online-primary-care-program-designed-to-meet-the-needs-of-young-patients/>

MOBILE HEALTH APPLICATIONS

Rank	Name	Points
1	Mayo Clinic, Rochester, Minnesota	414
2	Cleveland Clinic	385
3	Johns Hopkins Hospital, Baltimore	355
4	Massachusetts General Hospital, Boston	354
5	University of Michigan Hospitals-Michigan Medicine, Ann Arbor	324
6	UCSF Medical Center, San Francisco	296
7	UCLA Medical Center, Los Angeles	267
8	Cedars-Sinai Medical Center, Los Angeles	252
9	Stanford Health Care-Stanford Hospital, Stanford, California	250
10	New York-Presbyterian Hospital, New York	242
11 (tie)	Barnes-Jewish Hospital, St. Louis	241
11 (tie)	Mayo Clinic Phoenix	241
13	Northwestern Memorial Hospital, Chicago	228
14	Hospitals of the University of Pennsylvania-Penn Presbyterian, Philadelphia	225
15 (tie)	NYU Langone Hospitals, New York	208
15 (tie)	UPMC Presbyterian Shadyside, Pittsburgh	208
17	Vanderbilt University Medical Center, Nashville, Tennessee	198
18	Mount Sinai Hospital, New York	192
19	Duke University Hospital, Durham, North Carolina	178
20	Brigham and Women's Hospital, Boston	177

Note. Reprinted from “2018-19 Best hospitals honor roll and medical specialties rankings” by Comarow, A., & Harder, B. (2018, August 14). Retrieved from: <https://health.usnews.com/health-care/best-hospitals/articles/best-hospitals-honor-roll-and-overview>

MOBILE HEALTH APPLICATIONS

MOBILE HEALTH APPLICATIONS

Table 2. USNWR Honor Roll Comparison Spreadsheet

Healthcare Organization	# of Beds	Primary Portal App	Developer	Platforms	Features	Additional Apps
Mayo Clinic-#1	794 Methodist Campus 1,265-St. Mary's Campus 148-Children's Hospital	Mayo Clinic	Mayo Clinic	iPad, iPhone, iPod Touch, Android	*Appointment scheduling/ management *Secure provider messaging *Lab/Test results, clinical notes *News, nutrition, wellness advice *Bill pay *Express Care Online	*Mayo Clinic for Medical Professionals *ContrastTx (for employees) *AnxietyCoach (\$4.99)
Cleveland Clinic-#2	1,400-main campus, 4,538 system wide	Cleveland Clinic Today (MyChart embedded)	Cleveland Clinic Innovations (Epic)	iPad, iPhone, iPod Touch, Apple Watch Android	*Appointment scheduling/ management *Secure provider messaging *Lab/Test results, medical history *Upload fitness data *Access family health info *Bill pay	*Cleveland Clinic CME *DDSI Instant Opinion and Referral *Wellness Tip of the Day *Cancer Trials *GO! TO SLEEP® *Stress Free Now *Stress Free Now Healer's Version *Health Q&A *Healthy Brains *MyEpilepsy *Sideline Guidelines *ORAnywhere *Heart Story
UCSF	796	MyChart	Epic	iPad,	*Appointment scheduling/	*UCSF Center for Joint

MOBILE HEALTH APPLICATIONS

Medical Center-#5				iPhone, iPod Touch, Apple Watch, Android	<ul style="list-style-type: none"> management *Secure provider messaging *Lab/Test results, medical history *Upload fitness data *Access family health info *Bill pay 	Replacement
Stanford Health Center-#9	613	MyHealth	Stanford Health Care	iPad, iPhone, iPod Touch, Android	<ul style="list-style-type: none"> *Appointment scheduling/management *Secure provider messaging *Lab/Test results *Manage prescriptions/medications *Health summaries *Bill pay *Virtual Appointments *Share vital with provider 	<ul style="list-style-type: none"> *Stanford Children's Health *HealthySteps Benefits (for employees)
Brigham & Women's Hospital-#20	777	Partner's Patient Gateway	Partner's Healthcare System, Inc.	iPad, iPhone, iPod Touch, Android	<ul style="list-style-type: none"> *Appointment scheduling/management *Secure provider messaging *Lab/Test results *Manage prescriptions *Bill pay 	<ul style="list-style-type: none"> *Crohns & colitis symptom diary *Rheumatoid Arthritis symptom tracker *Asthma symptom tracker