

The Rise of Digital Health and Potential Implications for Pharmacy Practice

By Mickayla Clark, PharmD candidate 2017; Thomas Clark, PharmD candidate 2017; Afeefa Bhatti, PharmD candidate 2017; Timothy Aungst, PharmD

ARTICLE HISTORY

Published: January 2017

ABSTRACT

The rise of technology in healthcare has led to dramatic changes in approaches to patient care by healthcare professionals. The realm of digital health has created new opportunities for pharmacists to engage patients in clinical practice. Pharmacies and industry are increasingly integrating these innovations into their businesses and practice. This article highlights areas of digital health for pharmacists to be aware of, in particular regarding areas of medication adherence and disease management.

Technology plays a massive role in our individual lives; it has morphed the human experience in ways that were simply unimaginable 50 years ago. We use technology in nearly every facet of our lives. From detecting an appropriate intensity with which to brush our teeth to counting calories lost through the course of a day, technology has made a major impact on individual health. The integration of technology into our everyday lives has changed the way we communicate, how we capture and share our lives with others, how we seek answers, and how we experience life overall. Given this change in the way people operate, it is important that pharmacists adapt to these trends and incorporate technology into daily practice. The incorporation of mobile devices and technology into healthcare has been coined as mobile health (mHealth), which falls under the broader spectrum of digital health.¹⁻⁴ Digital health focuses on the integration of mobile tools (e.g., smartphones), wearable devices, and telehealth to help personalize the treatment of patients through the widespread adoption of wireless technology. The idea of involving pharmacists in mHealth has been a topic of recent interest, due in large part to the potential ramifications for the profession.⁴ Today, patients are using the Internet to research their health questions and help guide their personal health choices, and some of the information they

find can be misleading and unreliable. It is of the utmost importance that healthcare professionals ensure there are credible sources for patients to research their questions. As pharmacists, we can research and recommend tools to patients to help solve problems related to drug information, medication adherence, and access, which includes the recent rise of novel technological devices. All of our patients will have different comfort levels with technology; despite this spectrum, there is a place for everyone to feel comfortable using digital health tools. However, there are recent technological advances coming to the field, which are already providing a benefit to patients, ranging from mobile applications to wearable technologies to ingestible medications that notify providers of patient medication adherence. We seek to help pharmacists understand the different areas of digital health, which may have substantial influence on the realm of pharmacy practice in the years to come by addressing current and upcoming digital health developments.

Smartphones and Mobile Apps – How Pharmacies Are Leveraging Mobile

The ubiquitous smartphone has changed the way users approach their daily activities thanks to the myriad mobile applications (apps) available. This includes apps that can help with dating, sharing rides, and tracking daily activities. Along

with this, there is no shortage of mobile apps available on Google Play and the Apple App Store related to health, fitness, and medical services. These applications revolve around many topics including, but not limited to, nutritional eating, weight loss, medication adherence, and informatics. In many ways, the modern smartphone is an advanced personal digital assistant (PDA) that has garnered much interest in the past as a tool for clinicians.⁵ Many pharmacists have been quick to gravitate to the use of mobile apps to supplement their daily medical references (e.g., Lexicomp, Micromedex), and there are many apps they can use to help in patient care.⁶ Beyond the use of smartphones as mobile reference points, the use of apps for other services is captivating areas of pharmacy practice, such as order verification and communication amongst healthcare practitioners.⁷⁻¹⁰

Community pharmacies have not been late to this trend and have developed apps to promote their services and provide patients with essential tools. For instance, Walgreens, CVS, and other community pharmacies have created applications with different resources available for patients.^{11,12} After creating a login, patients are able to manage their medications from the convenience of their mobile device. They can choose to refill or transfer prescriptions, or simply access their medication profile from their mobile devices. These

community pharmacies have attempted to help increase adherence to medications by embedding “pill reminder” technology in their applications. Walgreens has been particularly innovative in adding tools designed to convenience patients. For instance, patients can submit their new insurance information simply by taking a picture of their prescription insurance card from their mobile device. Having access to the correct insurance information is helpful in saving time for patients, as they do not have to wait while pharmacy personnel submit their claim, and patients know in advance if their insurance does not cover the medication. Furthermore, Walgreens is on the forefront of revolutionizing the way patients communicate with medical personnel. From their mobile app, you can have a secure conversation with a pharmacist regarding health or receive medication-related answers. Lastly, given that pharmacists are playing a larger role in immunizations, this pharmacy has taken the initiative to have a section on their app dedicated to recording immunizations. Those received at Walgreens are automatically included, but patients can also add their own history. This allows patients to carry their immunization record everywhere they go, helping them to avoid any duplication in vaccinations.¹² Interestingly, recent studies have been conducted amongst users of pharmacy mobile apps.^{13,14} Results demonstrated that interviewees wanted an app to provide an improved pharmacy experience, to have features that supported self-management of their health, to have the ability to grant access to pharmacists directly, and to address concerns about privacy and access. It may come as no surprise that with time, many large pharmacies will gravitate toward a central mobile platform to meet many of their patients’ needs and expectations in the future. Taking that into consideration, CVS has recently launched its own digital innovation laboratory in Boston, Massachusetts to help foster new ideas and services related to the tech industry to help boost its technological developments.¹⁵

One area being actively explored by pharmacies is extending services that include telehealth platforms. There have been a number of mobile health companies that have recently developed online platforms to answer and address patients’ medical questions, as seen in Table 1. One example is HealthTap, an online company

that allows members to pose online questions to healthcare professionals (e.g., physicians, pharmacists) about medical issues and receive online consults from their phones.¹⁶ Looking to capitalize on this new means of reaching patients, pharmacy companies are seeking to develop telehealth services as well, utilizing physicians and pharmacists.¹⁷

Another layer of intrigue in the mobile app market has been a plethora of start-up companies seeking to create apps to help patients access and purchase their medications using their smartphones.^{18,19} These new companies look to provide patients with online services whereby they may scan their prescription and have it sent to the pharmacy to be filled to provide same-day drug delivery via these apps, as seen in Table 1. Many of these start-up companies are based in California, primarily around the San Francisco region, where they are looking to garner attention and investment with their business models. While these services are rather new and may be attractive to patients with the rise of on-demand services (e.g., Uber), the drawback will be less face time with pharmacists, which may prove detrimental to patient care. Nonetheless, with technology advancing, community pharmacies must continue to be innovative in their design in order to remain relevant, and pharmacists should be aware of how pharmacies are using technology to maximize patient care and services in a highly competitive market.

Digital Health for Medication Adherence – New Tools in Patient Care

Pharmacy-related digital health technology is not limited to mobile apps and technology tailored to a specific pharmacy. Rather, it branches out in the form of thousands of smartphone mobile apps and wearable technologies, encompassing medication adherence, monitoring of various disease states, and overall health and wellness, as seen in Table 1. This mobile health (mHealth) subset of digital health is being actively explored by pharmacists as a means of increasing clinical interventions amongst patient populations.⁴ Perhaps the main area in which many researchers believe pharmacists can make the largest impact on digital health is increasing medication adherence.²⁰

Medication adherence is a serious concern the healthcare system faces, with

medication nonadherence accounting for nearly \$300 billion dollars of avoidable healthcare spending.²¹ Medication adherence is crucial, especially when it comes to patients with one or more chronic conditions. Recent technological innovations have included customized short-messaging services (SMS) (i.e., texting), mobile apps, and smart devices to help improve medication adherence. While SMS is a relatively older intervention, with more than a decade’s worth of studies, it is still being actively pursued due to its low cost and large scalability to reach patients who may lack a smartphone.²² Moving beyond SMS, the creation of mobile apps to serve as a “virtual pillbox” have gained much interest, and many apps have entered the market. A review conducted by Dayer and colleagues sought to review the medication adherence apps available on the market and help identify apps that would be best for patients.²³ During the course of their review, Dayer and colleagues identified that many apps lacked key qualities that would help with adherence. Their overall work has culminated in identifying apps they have evaluated to be beneficial for patients, and they have created a website called medappfinder.com to help healthcare professionals recommend medication reminder apps for their patients.²⁴ One limiting factor behind the use of medication adherence apps at present is the current state of medical research demonstrating significant impact. There have been a number of studies investigating the use of text-based messaging to help with medication adherence, though research on the use of apps has been limited. Ongoing studies may help identify which apps and what interventions may prove beneficial in practice in the near future.^{25,26}

While apps themselves are a relatively novel approach to helping patients with their medication adherence, there have been several different approaches to solving the medication adherence issue with digital health. These include “smart” pill bottles that have the ability to remind patients to take their medications, can track when a patient removes a medication from the bottle, and broadcast that information via Bluetooth, as seen in Table 1. One example is Adheretech, a pill bottle that senses when the bottle is opened and how many pills are contained based on weight, which is currently involved in several ongoing clinical studies

to evaluate efficacy in practice.^{27,28} Even more advanced approaches include ingestible biosensors that can detect when a patient takes a medication. One of the main developers is Proteus Digital Health, which has been actively testing its FDA-approved product in multiple areas of healthcare.²⁹ Proteus is currently in the process of pursuing approval of a “smart” pill with Otsuka Pharmaceuticals’ Abilify drug product to address medication adherence in patients with mental health disorders. These smart pill products are also being tested for adherence in other disease states, and a recent publication in JAPhA identified the use of these ingestible biosensors to help pharmacists guide therapy in patients enrolled in a hypertension treatment program in Great Britain.³⁰ Lastly, pharmaceutical companies are actively exploring ways to integrate digital health technology into their existing products, including creating inhalers with integrated Bluetooth-enabled sensors, allowing providers to track their adherence and utilization with the hope of identifying nonadherence or the need for therapy escalation.³¹

While the premise is these new tools can help objectively assess patients’ adherence rates, especially in populations prone to nonadherence, they are still in their infancy. Pharmacists will more likely see these products become increasingly available to patients, especially those with chronic diseases requiring intensive adherence to prevent disease progression or symptoms. Pharmacy case managers in particular could benefit from the use of these tools to keep track of patients’ medication adherence and help with the reconciliation process between in- and outpatient management. The technology available may help keep better records that can inform community pharmacists and providers on what medications are being utilized and perhaps reduce medication errors leading to negative patient outcomes. The key factor will be the reimbursement models by insurance companies electing to allow patients to use such products; this will become more clear once results from ongoing studies are published. Using sensors to track medication adherence is a factor that may help providers determine the best treatment regimen for the patient. Assessing adherence to treatment regimens would no longer solely rely on patient reporting. The data will show the exact date and time a

medication was taken. It has the potential to save the healthcare system a significant amount of money while at the same time improving the patient’s quality of life by reducing unnecessary adverse effects and hospital visits due to nonadherence.

Digital Health Tools – Patient-Empowered Monitoring

Going beyond medication adherence, the use of digital health in practice may enable pharmacists to embrace more clinical responsibilities. There are currently many apps on the market directed for disease management and an increasingly developed market of smart devices for chronic disease assessment. For example, many apps exist to help with the management of diabetes, with key features of these apps typically including a blood glucose log, medication “pillbox,” weight chart, and diet log. These features can be very helpful, as typically this information can be exported and given to the healthcare provider responsible for the patient’s treatment. This also gives the patient more insight into their health, as they have a place to log their diet, medication/insulin usage, and blood sugar. The overall goal of recommending these apps is to put the patient in control of their own health, while also allowing patients to share their data in real time with their providers and caregivers. The provider can then better assess the patient’s condition, medication adherence, and therapeutic efficacy. Changes to medication therapy could then be made depending on the patient’s results. Pharmacists have been actively involved in telehealth management for patients with diabetes and hypertension, and these apps and digital services could offer a potential way to access needed data for care.^{32,33}

Pharmacists will also likely see an increasing number of digital health devices slowly enter the pharmacy in the near future. While wearable fitness devices (e.g., Fitbit) have seen a large uptake in society, other devices, are also gaining a large traction in the health industry. These include products by Withings (now owned by Nokia), which has created a line of smart Bluetooth-enabled devices, including blood pressure monitors, weight scales, and health trackers, that are being sold widely throughout the United States. Other devices, such as that by AliveCor, can be attached to the back of patients’ iPhones, turning them into EKGs and tracking their

heart rhythms. This device is currently FDA approved and has been tested by pharmacists in Australia to identify patients with undocumented atrial fibrillation.³⁴ Nonetheless, as these devices become more predominant in healthcare as a whole, they offer a significant opportunity for pharmacists to educate their patients on their use and integrate the data into patient care.

Considerations on the Future of Digital Health

Medication adherence and helping patients reach their health goals are two focuses seen across all pharmacy settings. With numerous digital health options available, ultimately the most ideal form of technology is dependent on the capabilities of each individual patient. There are many factors to consider when utilizing technology for patients, which could include financial barriers, technology literacy, age, physical disabilities, and simply the willingness to put extra effort into using the app or wearable device. Many of these apps and products can be expensive and out of a patient’s price range; one of the largest criticisms has been that patients who may benefit most from such services may not be able to afford them. The lynchpin of these services will be reimbursement for use by insurance companies or health agencies. Additionally, physical disabilities such as visual impairments could prevent a patient from using these apps and products. Age and technology literacy is an area where some research has been done. One study in a population of people aged 50 and older showed there was no benefit from utilizing a diabetes app, with the main problem being lack of ease of use.³⁵ Many of the patients felt it was not worth the effort and found the app difficult to operate and read. On the other hand, another study performed on people aged 50 and older with chronic illnesses utilizing wearable activity tracking devices had different results.³⁶ This population found the tracking devices very helpful, with the stipulation that someone was there to assist in setting up the device and helping interpret the data. Other studies have also demonstrated many patients are amenable to the integration of mobile devices and apps to help manage their medication therapies.^{37,38}

Overall, the breadth of research in the digital health field is in its nascent stage,

with much speculation about its overall impact. There are multiple studies currently in process that will help determine what tools and services may ultimately benefit patients. Nonetheless, recent research is demonstrating the limitations of digital health tools. For one, there are multiple “bad” apps available on the market that could prove negative in patient care. For instance, recent publications in *JAMA Internal Medicine* identified apps that did not function as advertised, namely a blood pressure app that purported to calculate blood pressure from the smartphone camera, and a minireview demonstrated that many diabetes apps are not securing patient information.³⁹⁻⁴² Another study, the BEAT-HF study, demonstrated the use of digital health tools did not help reduce the readmission rates in patients with a recent heart failure exacerbation.⁴³ Nonetheless, there are a number of studies that have shown the benefits of digital health, such as the CHAMPION study where a remote patient monitoring system using an implantable microelectromechanical pulmonary artery pressure monitoring system was utilized to help manage heart failure patients and reduce hospitalization.^{3,44} While some of these interventions may be more invasive in their current form (e.g., implantation), digital health strives to make technology easier for patients and clinicians to utilize, and is demonstrative of its potential impact on high-risk diseases. These studies have demonstrated the initial flaws and successes of digital health interventions, and they may help future researchers and developers recognize more appropriate interventions to make and help the design process.

Conclusion

The idea of digital health apps, wearable device utilization, and incorporation of dosage sensors in medication has the potential to revolutionize the way we practice pharmacy. They help bridge the gap between adherence, access, wellness, and chronic disease management. For these reasons, the incorporation of digital health into the curriculum for future pharmacists, as well as continuing education for current pharmacists, should be considered. While integrating technology into pharmacy, it is important to keep in mind that patients come from different technology literacy levels. With technology being such a key component of our lives, it is clear to see that many would benefit.

More technology aimed at combating the lack of medication adherence is emerging, trying to provide user-friendly devices and applications centered around the patient. As we move forward, these technologies will become more financially feasible for the average consumer. The development of new technology with fewer limitations is becoming increasingly more important and will play a bigger role in how pharmacy is practiced.

About the Authors

Mickayla Clark, PharmD candidate 2017, is a pharmacy student at MCPHS University, Worcester, Massachusetts. Mrs. Clark has no bias to report.

Thomas Clark, PharmD candidate 2017, is a pharmacy student at MCPHS University, Worcester, Massachusetts. Mr. Clark has no bias to report.

Afeefa Bhatti, PharmD candidate 2017, is a pharmacy student at MCPHS University, Worcester, Massachusetts. Miss Bhatti has no bias to report.

Timothy Aungst, PharmD, is an assistant professor of pharmacy practice at MCPHS University, Worcester, Massachusetts. Dr. Aungst is a freelance writer for *Pharmacy Times* on technology in healthcare and a senior editor at *Ranked Health*. He has given multiple national and international talks on the topic of digital health in the realm of healthcare and pharmacy. He can be followed on Twitter at @TDAungst.

References

1. World Health Organization. Towards the development of an mHealth Strategy: A literature review. 2008. http://www.who.int/goe/mobile_health/mHealthReview_Aug09.pdf (accessed July 16, 2016)
2. Elenko E, Underwood L, Zohar D. Defining digital medicine. *Nat Biotechnol*. 2015;33(5):456-61.
3. Bhavnani SP, Narula J, Sengupta PP. Mobile technology and the digitization of healthcare. *Eur Heart J*. 2016;37(18):1428-38.
4. Clauson KA, Elrod S, Fox BI, Hajar Z, Dzenowagis JH. Opportunities for pharmacists in mobile health. *Am J Health Syst Pharm*. 2013;70(15):1348-52.
5. Baumgart DC. Personal digital assistants in health care: Experienced clinicians in the palm of your hand? *Lancet*. 2005;366(9492):1210-22.
6. Dasgupta A, Sansgiry SS, Sherer JT, Wallace D, Sikri S. Pharmacists' utilization and interest in usage of personal digital assistants in their professional responsibilities. *Health Info*

- Libr J. 2010;27(1):37-45.
7. Aungst TD. Medical applications for pharmacists using mobile devices. *Ann Pharmacother*. 2013;47(7-8):1088-95.
8. Haffey F, Brady RR, Maxwell S. Smartphone apps to support hospital prescribing and pharmacology education: A review of current provision. *Br J Clin Pharmacol*. 2014;77(1):31-8.
9. Ray SM, Clark S, Jeter JW, Treadway SA. Assessing the impact of mobile technology on order verification during pharmacist participation in patient rounds. *Am J Health Syst Pharm*. 2013;70(7):633-6.
10. Przybylo JA, Wang A, Loftus P, Evans KH, Chu I, Shieh L. Smarter hospital communication: Secure smartphone text messaging improves provider satisfaction and perception of efficacy, workflow. *J Hosp Med*. 2014;9(9):573-8.
11. CVS Pharmacy. Apple App Store. <https://itunes.apple.com/us/app/cvs-pharmacy/id395545555?mt=8> (accessed May 20, 2016)
12. Walgreens Pharmacy. Apple App Store. <https://itunes.apple.com/us/app/walgreens-pharmacy-coupons/id335364882?mt=8> (accessed May 20, 2016)
13. McCartney E, Bacci JL, Ossman KL, et al. Mobile application features sought after by patients of a regional grocery store chain pharmacy. *J Am Pharm Assoc*. 2016;56(1):62-66.
14. Didonato KL, Liu Y, Lindsey CC, Hartwig DM, Stoner SC. Community pharmacy patient perceptions of a pharmacy-initiated mobile technology app to improve adherence. *Int J Pharm Pract*. 2015;23(5):309-19.
15. CVSHealth. CVS health Opens Digital Innovation Lab in Boston. <http://cvshealth.com/newsroom/press-releases/cvs-health-opens-digital-innovation-lab-boston> (accessed May 20, 2016)
16. HealthTap. <https://www.healthtap.com/> (accessed May 20, 2016)
17. Polinski JM, Barker T, Gagliano N, Sussman A, Brennan TA, Shrank WH. Patients' Satisfaction with and Preference for Telehealth Visits. *J Gen Intern Med*. 2016;31(3):269-75.
18. nurx. <https://app.nurx.co> (accessed August 31, 2016)
19. ScriptDash. <https://scriptdash.com> (accessed August 31, 2016)
20. Davies MJ, Kotadia A, Mughal H, Hannan A, Alqarni H. The attitudes of pharmacists, students and the general public on mHealth applications for medication adherence. *Pharm Pract (Granada)*. 2015;13(4):644.

21. Varshneya, A. Medication Non-Adherence: A \$290 Billion Unnecessary Expenditure. HealthWorksCollective. April 13, 2015. <http://www.healthworkscollective.com/ashish-varshneya/300471/medication-non-adherence-290-billion-unnecessary-expenditure>. (accessed January 25, 2016)
22. Kamal AK, Shaikh QN, Pasha O, et al. Improving medication adherence in stroke patients through Short Text Messages (SMS4Stroke)-study protocol for a randomized, controlled trial. *BMC Neurol*. 2015;15:157.
23. Dayer L, Heldenbrand S, Anderson P, Gubbins PO, Martin BC. Smartphone medication adherence apps: Potential benefits to patients and providers. *J Am Pharm Assoc*. 2013;53(2):172-81.
24. Heldenbrand S, Martin BC, Gubbins PO, et al. Assessment of medication adherence app features, functionality, and health literacy level and the creation of a searchable Web-based adherence app resource for health care professionals and patients. *J Am Pharm Assoc*. 2016;56(3):293-302.
25. Anglada-Martinez H, Riu-Viladoms G, Martin-Conde M, Rovira-Illamola M, Sotoca-Momblona JM, Codina-Jane C. Does mHealth increase adherence to medication? Results of a systematic review. *Int J Clin Pract*. 2015;69(1):9-32.
26. Choi A, Lovett AW, Kang J, Lee K, Choi L. Mobile applications to improve medication adherence: Existing apps, quality of life, and future directions. *Adv Pharmacol*. 2015;3(3):64-74.
27. Adheretech. <https://adheretech.com/> (accessed May 20, 2016)
28. Clinicaltrials.gov. Keep it SIMPLE: Improving Anti-Coagulation Medication Adherence. <https://clinicaltrials.gov/ct2/show/NCT02690649> (accessed May 20, 2016)
29. Proteus Digital Health. <http://www.proteus.com/> (accessed May 20, 2016)
30. Noble K, Brown K, Medina M, et al. Medication adherence and activity patterns underlying uncontrolled hypertension: Assessment and recommendations by practicing pharmacists using digital health care. *J Am Pharm Assoc*. Published online April 1, 2016.
31. Chan AH, Reddel HK, Apter A, Eakin M, Riekert K, Foster JM. Adherence monitoring and e-health: How clinicians and researchers can use technology to promote inhaler adherence for asthma. *J Allergy Clin Immunol Pract*. 2013;1(5):446-54.
32. Maxwell LG, Mcfarland MS, Baker JW, Cassidy RF. Evaluation of the Impact of a Pharmacist-Led Telehealth Clinic on Diabetes-Related Goals of Therapy in a Veteran Population. *Pharmacotherapy*. 2016;36(3):348-56.
33. Margolis KL, Asche SE, Bergdall AR, et al. Effect of Home Blood Pressure Telemonitoring and Pharmacist Management on Blood Pressure Control: A Cluster Randomized Clinical Trial. *JAMA*. 2013;310(1):46-56.
34. Lowres N, Neubeck L, Salkeld G, et al. Feasibility and cost effectiveness of stroke prevention through community screening for atrial fibrillation using iPhone ECG in pharmacies. The SEARCH-AF study. *Thromb Haemost*. 2014;111(6):1167-76.
35. Scheibe M, Reichelt J, Bellmann M, Kirch W. Acceptance Factors of Mobile Apps for Diabetes by Patients Aged 50 or Older: A Qualitative Study. *JMIR*. 2015;4(1): e1. doi: 10.2196/med20.3912
36. Mercer K, Giangregorio L, Schneider E, Chilana P, Li M, Grindrod K. Acceptance of Commercially Available Wearable Activity Trackers Among Adults Aged Over 50 and With Chronic Illness: A Mixed-Methods Evaluation. *JMIR mHealth uHealth*. 2016;4(1): e7. doi: 10.2196/mhealth.4225.
37. Jenkins C, Burkett NS, Ovbiagele B, et al. Stroke patients and their attitudes toward mHealth monitoring to support blood pressure control and medication adherence. *Mhealth*. 2016;2 DOI: 10.21037/mhealth.2016.05.04
38. Browning RB, McGillicuddy JW, Treiber FA, Taber DJ. Kidney transplant recipients' attitudes about using mobile health technology for managing and monitoring medication therapy. *J Am Pharm Assoc* (2003). 2016;56(4):450-454.e1.
39. Plante TB, Urrea B, Macfarlane ZT, et al. Validation of the Instant Blood Pressure Smartphone App. *JAMA Intern Med*. Published online March 2, 2016.
40. Blenner SR, Köllmer M, Rouse AJ, Daneshvar N, Williams C, Andrews LB. Privacy Policies of Android Diabetes Apps and Sharing of Health Information. *JAMA*. 2016;315(10):1051-2.
41. Agboola SO, Bates DW, Kvedar JC. Digital Health and Patient Safety. *JAMA*. 2016;315(16):1697-8.
42. Huckvale K, Prieto JT, Tilney M, Benghozi PJ, Car J. Unaddressed privacy risks in accredited health and wellness apps: a cross-sectionally systematic assessment. *BMC Med*. 2015;13:214.
43. Ong MK, Romano PS, Edgington S, et al. Effectiveness of Remote Patient Monitoring After Discharge of Hospitalized Patients With Heart Failure: The Better Effectiveness After Transition-Heart Failure (BEAT-HF) Randomized Clinical Trial. *JAMA Intern Med*. 2016 Mar;176(3):310-8
44. Krahnke JS, Abraham WT, Adamson PB, et al. Heart failure and respiratory hospitalizations are reduced in patients with heart failure and chronic obstructive pulmonary disease with the use of an implantable pulmonary artery pressure monitoring device. *J Card Fail*. 2015;21(3):240-9.

Table1: Sample Digital Health Devices and Services

Category	Interventions	Description
Medication Adherence	Proteus Digital Health (http://www.proteus.com/)	Ingestible sensor that can be incorporated into an oral medication that gives an alert when a medication enters the gastrointestinal tract
	Adheretech (https://www.adheretech.com/) GlowCap (http://www.vitality.net/index.html) MediSafe iConnect (http://www.medisafeconnect.com/)	Smart pill bottles that incorporate sensors to give an alert when a medication is removed from the bottle or container
Cardiology	Kardia (https://www.alivecor.com/en/)	Device mounted on a smartphone or the wrist (smartwatch connection) that can read heart rhythm
	Blood Pressure Cuffs – multiple companies such as Withings (http://www.withings.com/us/en/), Omron, iHealth (https://ihealthlabs.com/)	Traditional blood pressure cuffs that are Bluetooth enabled to connect to mobile devices for data export
Diabetes	Dexcom (http://www.dexcom.com/)	Continuous glucose monitoring device that is worn by a patient
	Glucometers – multiple companies, iHealth (https://ihealthlabs.com/), iBGStar (http://www.mystarsanofi.com/web/products/glucometers/ibgstar)	Traditional glucose monitoring devices that are Bluetooth enabled or directly connect to a mobile device for data export
Telehealth Services	HealthTap (https://www.healthtap.com/) GoGoHealth (https://www.gogohealth.com/) Doctor on Demand (http://www.doctorondemand.com/) Teladoc (https://www.teladoc.com/) TelePharm (https://www.telepharm.com/)	Mobile app or web-based services allowing patients to talk to a healthcare professional
Drug Delivery	Nurx (https://app.nurx.co/)	Start-up focused on allowing patients to contact a provider for birth control, which will then be delivered
	ZipDrug (https://www.zipdrug.com/) PopRx (https://www.poprx.ca/) - Canada based Script Dash (https://scriptdash.com/)	Companies that promise same-day drug delivery. Services vary in how prescriptions are sent to the pharmacy.