# Chapter 8
# Advancements in Health Care Communication

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## 1 Introduction

Information technology (IT) is changing the way patients and health care providers communicate with each other. Surveys have shown that over a third of American adults self-diagnose when they encounter a health problem and over 70% of American adults utilize the Internet as a resource for medical information (Hochberg et al., 2020). Surveys from 2021 report over 280 million smartphone users in the United States, which is 85% of the 2020 U.S. population (https://www.census.gov/quickfacts/fact/table/US/PST045219). Growth of the number of available digital health apps has paralleled recent exponential growth of cell phone and Internet usage (Smith, 2021). For health care professionals and their patients, these advancements provide opportunities to achieve new types of health care flexibility and convenience.

The medical provider is no longer the sole, authoritative source for health care information for most consumers. The onus is now on health care providers to keep pace with this innovation by offering patients a care experience customized to them through effective data management that allows for customized care experiences enabled through delivery of timely, relevant patient information. This chapter will address how to manage the technology and communication channels that are changing the health care system.

Proactive psychologists using new communication technologies will face strategic questions about patient data and its flow through the various actors within a

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L. C. James et al. (eds.), *Clinical Health Psychology in Military and Veteran Settings*, https://doi.org/10.1007/978-3-031-12063-3_8

health care system. How the data are stored, which individuals have access to specific types of data, and when the data are accessed are all important considerations for creating a competitive data-driven health care service. The field of clinical psychology is not immune to these changes. Phenomena once considered novel are now commonplace: patients entering behavioral data into their mobile phones, psychologists conversing with patients remotely, and psychological assessments conducted with the support of artificial intelligence. Understanding and adapting to these new phenomena will require careful analyses of the actors, the technology, and the data involved in these innovations.

This chapter will discuss developments in the field of health care communication that have begun to change the industry, as well as several issues that must be addressed as providers develop strategies for integrating these innovations into their workflows. This chapter includes five sections. Section 1 is this introduction. Section 2 will discuss three technologies that are changing the way patients communicate with providers: self-diagnostic tools, mobile health, and telehealth. Section 3 will address the five channels of communication that are managed in a technologically integrated health care environment along with five scenarios involving patients, providers, and technology. Section 4 is the conclusion.

## 2 Types of Technology

### *2.1 Self-Diagnostic Tools*

Delivery of health information is not a one-way line of communication from provider to patient. As connectivity becomes more ubiquitous, health care providers are no longer the sole sources of health advice available to patients. Patients are now able to access information independently based on what has been communicated to them from their health records. Thanks to the many resources made available through information technology, patients can now independently search for information on their health conditions and read reports from other patients and medical professionals. In conducting these searches, patients can identify additional medical options that their health care providers may not have mentioned. Clinicians aware of these self-diagnostic tools and their capabilities can strengthen communications with patients, gather information about patient concerns and ensure that quality of care remains consistent.

Self-diagnostic tools began with basic symptom-checking of common conditions such as influenza or the common cold, but have now expanded to expert systems that encompass a myriad of conditions, including conditions such as ear infections, chronic conditions such as diabetes, and mental health conditions such as depression (Amisha et al., 2019). These innovations are driven by advances in artificial intelligence. As more data is supplied to these diagnostic tools, the predictions become more accurate within the context of the data pool (Fan et al., 2020; Jiang et al., 2017). The success of these tools has given rise to a new movement in health care consumerism: the educated and empowered patient or e-patient.

E-patients are health consumers who participate fully in their own medical care. They gather information about their health conditions from their health care providers and then use the Internet and other digital tools to obtain additional information. The term encompasses those who seek guidance for their own ailments, and the friends and family members who go online on their behalf. In the past, patients were more likely to seek external sources of information if the condition being treated was severe, such as cancer (Beisecker & Beisecker, 1990; Lambert & Loiselle, 2007). While the propensity for patients to seek external information is still higher for severe conditions, it is not uncommon now for patients to seek additional information sources for relatively minor conditions such as a seasonal allergy (Jacobs et al., 2017). This emergence of the informed consumer follows phenomena observed in other industries such as online retail (Major, 2019). The information asymmetry between patients and providers tends to be greater in health care than in other contexts due to the typical gap in expertise between patients and health care providers. However, the trend toward a more informed patient, facilitated by the vast amounts of information available online and the tools to simplify that information, may transform the health care industry the same way it has transformed others. In practice, online diagnostic tools are data-driven expert systems that rely on consistent feedback to improve future predictions.

Analysts discussing this potential impact of online information are not suggesting that patients will self-diagnose and self-treat serious conditions without consulting medical professionals. Instead, they suggest that patients may use the online self-diagnostic tools to assess whether it would be useful to seek professional help, or to address minor issues.[1]

A common flowchart for these diagnosis tools from the user's perspective is presented in Fig. 8.1. The flow chart walks through the progression of a patient as she accesses an online diagnostic system. The flowchart is separated by actors, actions that the patient would take are indicated by the nodes in the upper lane, while actions that the system would take are in the bottom lane. The patient begins by entering demographic data and selecting symptoms from lists. The diagnostic

[1] The book, *The Innovator's Prescription*, distinguishes between conditions treated with rules-based health care and conditions treated with intuitive care. Conditions treated with rules-based care are diagnosed using a straightforward test or readily observed symptoms, and treatment is guided by straightforward algorithmic treatment recommendations. Conditions requiring intuitive care are more difficult to diagnose, and they may require treatment regimens that are tailored to meet patient-specific requirements. The authors of *The Innovator's Prescription* argue that disruptive technologies may be useful for conditions that require rules-based diagnosis and treatment, but they are less likely to be useful for conditions requiring intuitive care. (Christensen, C, Grossman, J., and Hwang, J. (2009) The Innovator's Prescription. McGraw-Hill Education.

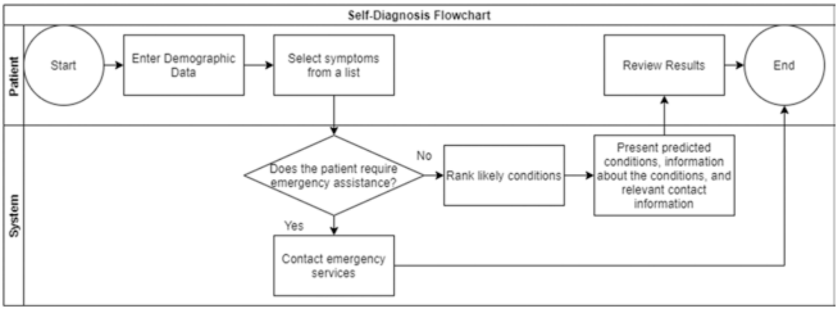


**Fig. 8.1** Flowchart for an online diagnostic system

Gender: Male

Age: 51

Reported Symptoms: Headache, cough, fever between 100.4 to 102 f

**Possible conditions**

| | | |
|---|---|---|
| **Influenza** | **Moderate Match** | ***More Information*** |
| **Bac. Pneumonia** | **Moderate Match** | ***More Information*** |
| **Common Cold** | **Fair Match** | ***More Information*** |
| **Coronavirus** | **Fair Match** | ***More Information*** |

**Fig. 8.2** Template of typical physical health symptom checker results

system uses this information to make a determination, indicated by the diamond shape, on the question of whether the patient requires immediate emergency assistance. An example would be whether the patient reports an immediate difficulty breathing, a sensation nearing unconsciousness, or a direct indication that she requires immediate support. If the patient requires immediate care, the system recommends that the patient seek emergency care. If not, the system ranks possible diagnoses indicated by the patient's self-reported symptoms to provide a set of possible diagnoses, along with their calculated probabilities based on the symptoms reported. This type of system is patient-driven, with no human actor on the other end besides an expert system that uses the patient's data to generate a series of predictions.

Example results of these self-diagnostic tools are presented in Figs. 8.2 and 8.3. These reporting screens are shown to the patient at the end of the data entry and symptom evaluation process. Often the data the patient has entered are presented back to the patient for review. The likelihood of potential conditions is also reported. Most of these diagnostic tools provide an option for patients to access more information about any of the reported conditions. This feature guides the patient toward

Based on your responses, your depression test score was:

**Moderate Depression (11/20)**

Your responses indicate that you may be at risk of harming yourself or someone else. If you are in need of immediate assistance, please call the National Suicide Prevention Hotline to speak to a trained counselor.

***More information about your results***

***Revise your answers***

***Take another test–***

**Fig. 8.3** Template of typical mental health symptom checker results

further research and may lead them to take proactive measures to address potential conditions.

Figures 8.2 and 8.3 provide illustrative examples of the types of results provided by self-diagnostic tools available online. Table 8.1 provides a summary of currently available tools along with links to the websites.

These systems use the information entered by the patient to generate a set of potential diagnoses. Most of these tools also provide resources for patients to learn more about the conditions, and possibly contact medical professionals virtually. If geolocational systems are involved, then these diagnostic assistants can recommend nearby health care providers and provide contact information directly through the interface.

While patient self-diagnosis tools can potentially guide patient decisions to seek care and may boost patient engagement in managing self-care behaviors, they also pose risks and dangers. Patient-driven information-seeking runs all the risks of any type of unsupervised browsing of the Internet (Liu et al., 2019). Self-diagnosis tools

**Table 8.1** Self-assessment tools available online

| Name | Description | Website |
| --- | --- | --- |
| Mental Health Test | A collection of tests including depression, PTSD, addiction, and work health provided by the organization Mental Health America | https://screening.mhanational.org/screening-tools/ |
| Symptomate | A general health checkup that determines the likelihood of health conditions based on user-input symptoms | https://symptomate.com/diagnosis/#0-66 |
| WebMD Symptom Checker | A health checkup with additional functionality, including visual indicators for symptom locations and follow-up resources for health care assistance | https://symptoms.webmd.com/ |
| Mental Health assessments from Psycom | A collection of self-assessment and screening tools for conditions, including depression, grief, ADHD, autism, bipolar disorder, addition, and stress | https://www.psycom.net/quizzes |

can generate misleading predictions due to either weaknesses in the artificial intelligence embedded in specific self-diagnosis tools, or inaccurate information provided by patients. If patients act on these conditions and self-medicate for an incorrectly diagnosed condition, then the potential for harm increases due to exacerbation of a condition or the development of a new condition. Additionally, not all patients will exhibit information-seeking behavior equally. Factors such as patient educational status, access to the Internet, and trust in online health information can affect the search for information and how likely patients are to act upon advice from a source other than a health care provider (Morgan & Trauth, 2013; Peek et al., 2014).

Providers aware of the existence of these systems can communicate with patients to determine whether they are utilizing these resources as an additional source of information on their conditions. Providers can further limit the potential harm by recommending supported tools they are familiar with, and by asking patients to share the results from these self-diagnostic tests. By opening this channel of communication, providers can gain insight into patient concerns about their symptoms. With proper supervision, online diagnostic tools and the wider Internet at large can serve as a source of supporting information. Providers can advise patients to be critical about information obtained from these tools and to consult with a professional before following a course of treatment not directly prescribed by their clinician.

## *2.2 Mobile Health*

Mobile health encompasses any device that can be carried or worn to decrease the temporal and spatial constraints associated with traditional health care (Steinhubl et al., 2015; Varshney, 2014). The goal of mobile health is to improve the health, comfort, and wellness of patients through information technology. Mobile health devices can be smartphone applications, wearable devices, or devices that are surgically implanted into a patient's body. Mobile health applications are the most popular form of mobile health intervention in use today due to the ubiquity of smartphones and the low overhead compared to dedicated devices. Therefore, this section will focus on implementation of mobile health apps as this is the most prevalent form of mobile health. The guidelines and considerations discussed in this section are also relevant to wearable and implanted mobile health technologies.

Commercial mobile health apps (such as apps provided on the Android or Apple application markets) and devices (such as FitBit or Apple Watch) are now capable of storing and transmitting information through a network. Over two-thirds of hospitals in North America integrate some form of mobile health in patient care, including mobile applications integrated with hospital electronic health records (EHRs) and applications designed to support maintenance activities such as medication adherence (Dick et al., 2020; Llorens-Vernet & Miró, 2020). In the field of clinical psychology, government applications, such as the Post Traumatic Stress Disorder (PTSD) Coach, Insomnia Coach, and VetChange, are providing additional resources

**Table 8.2** Mobile applications from the US Department of Veterans' Affairs

| Application name | Website |
|---|---|
| PTSD Coach | https://mobile.va.gov/app/ptsd-coach |
| Insomnia Coach | https://mobile.va.gov/app/insomnia-coach |
| Exposure Ed | https://mobile.va.gov/app/exposure-ed |
| Live Whole Health | https://mobile.va.gov/app/live-whole-health |
| Mindfulness Coach | https://mobile.va.gov/app/mindfulness-coach |
| Stay-Quit Coach | https://mobile.va.gov/app/stay-quit-coach |
| Rx Refill | https://mobile.va.gov/app/rx-refill |
| Mindfulness Coach | https://mobile.va.gov/app/mindfulness-coach |
| CBT-i Coach | https://mobile.va.gov/app/cbt-i-coach |
| AIMS for Anger Management | https://mobile.va.gov/app/anger-and-irritability-management-skills-aims |
| VA Online Scheduling | https://mobile.va.gov/app/va-online-scheduling |

to patients to obtain information about their conditions and to track information relevant to these conditions. Patient adoption of mobile devices and apps is growing. The informed clinician can utilize these developments to improve her care strategies and provide patients with a richer care experience. (See Table 8.2 for a list of mobile health applications provided by the US Department of Veterans' Affairs.)

## *2.3 Telehealth and Virtual Health Care*

Telepsychology is a growing technology area in treating symptoms such as PTSD, depression, anxiety, eating disorders, adjustment disorders, and substance abuse. The virtual component of these visits has been around for years, with the telephonic consultation solution's inception in 1960 as an attempt to connect with hard-to-reach populations. For the behavioral psychologist, telehealth or telepsychology is just one component of the emerging health care technology landscape. The challenge is to have this facet of pertinent patient data readily available to be shared with other care team members.

The COVID-19 pandemic from 2019 to 2021 placed pressure on society to accelerate innovation in the field of digital collaboration. In the health care field, telehealth and digital health (mHealth and health information technologies) saw many improvements. During the spring of 2020, when approximately 90% of the US population was under "stay at home" orders, telepsychology visits were the only option for most individuals seeking treatment. The easing of payment requirements by Medicaid, Medicare, and private insurance carriers along with the easing of licensure requirements by regulatory and state bodies also drove innovation in this field.

A sample visual of a common telehealth-enabled system from the clinician's perspective is presented in Fig. 8.4.

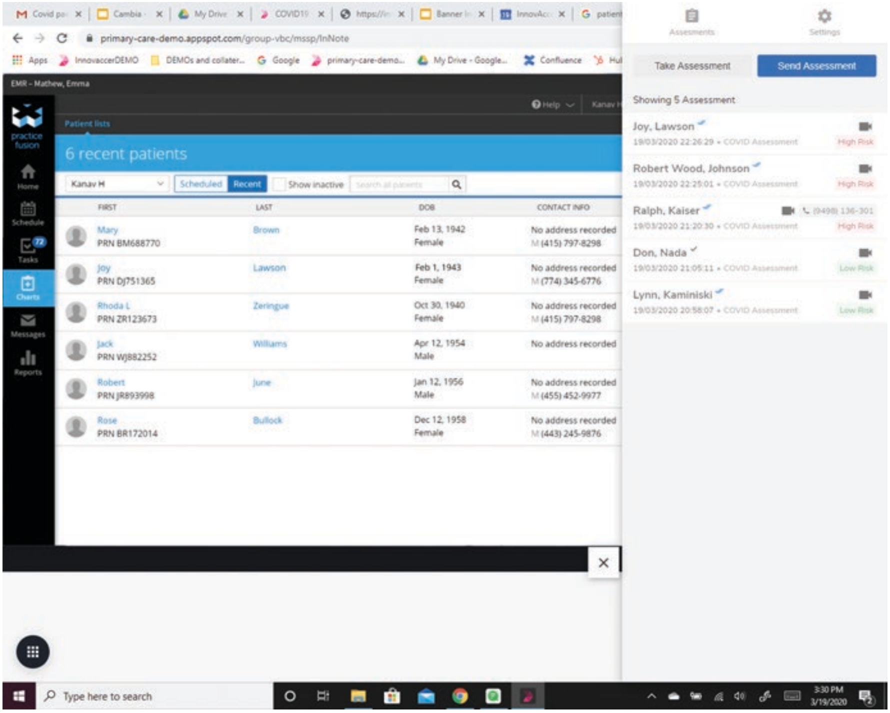


**Fig. 8.4** Sample telehealth conferencing system from provider's perspective

The image presents the view from the clinician's side, where access to patient contact information is available through a portal accessible through a web browser. Patients can be ranked based on priority, and teleconference calls to patients can be scheduled and made through the same interface.

Teleconferencing software can be used to schedule patient visits, assign priorities, and keep track of the data generated during the visits all within one system. This software is likely to become increasingly useful, as vendors expand these capabilities to include patient feedback channels, along with data processing, and analytics. In addition, analytical tools can be developed to identify patterns from visits and make suggestions for future scheduling decisions. Strategic issues that will be considered by clinicians using telehealth include:

1. What data generated during the visit are recorded?
2. What information generated from the visit is shared?
3. Who has access to this information?
4. Is the sharing process automated?

Telehealth technology can be coupled with remote monitoring to augment support for aging in place, address home care worker shortages,[2] and reduce the administrative burdens associated with Long-Term Services and Supports by consolidating and automating relevant administrative workflows. In the behavioral psychology field, automated sentiment analysis of patient transcripts can serve as an additional layer of decision support for the health care provider (Provoost et al., 2019; Rajput, 2020).

Modern smartphones are now considered to be as effective for teleconferencing as laptops or desktop computers (Hurst, 2020). How videos are stored, what information is needed prior to a visit, and how visit reports are generated and shared are just a few of the questions that will arise while designing and implementing a data-driven telehealth system. Detailed interactions between clinicians and technology managers will be needed during the planning phase of the technology adoption and implementation process to ensure careful consideration of these issues. Thoughtful decisions are essential to ensure that technology adoption generates a return on investment and strengthens patient health outcomes.

## 3 Communication Channels

A recurring theme in discussions of health care quality is communication. These discussions traditionally focused on communication between health care providers. However, technological advancements are creating new opportunities for increased connectivity and communication between patients and providers. The successful integration of mobile devices can facilitate increased efficiency within a health care system as patients use these tools to track their own health progress, report information to clinicians, and store data pertaining to their individual health.

This section focuses on analysis of communication channels. Analysis of the flow of information through a set of communication channels provides a useful framework for examination of decisions facing clinicians, as patients increasingly utilize mobile apps, self-diagnosis tools, and telehealth.[3] These technologies introduce new sources of information, new types of data, and potential communication channels that were not included in traditional health care interactions. As clinicians consider strategic options for addressing these new technologies, this framework can help structure their assessments of alternate strategies. This discussion of

[2] A substantive complaint voiced by personal care aides (PCAs) is gaps in communication between health care providers and PCAs. PCAs help patients implement health care recommendations, but they do not always receive information about these recommendations directly. (Osterman, P. [2017] Who will care for us? Long-term care and the long-term workforce. Russell Sage Foundation. 232 pages. ISBN-13: 978-0871546395).

[3] The academic discipline that focuses on the adoption and usage of technology by individuals and organizations is known as Information Systems. University Information Systems departments are typically located within Colleges of Business.

channels is combined with a presentation of five possible health care scenarios. At the conclusion of this section, the reader will have a useful framework to structure assessments of the challenges and opportunities offered by the new technologies. The reader will also be familiar with questions that are likely to arise as provider organizations develop strategic responses to patient engagement with the new technologies. Finally, she will be familiar with evaluation criteria for assessing mobile apps and communicating requirements to developers.

## *3.1 Scenario 1: Traditional Health Care Model*

Prior to the introduction of EHR systems, there was a single communication channel between patients and providers, as illustrated in Fig. 8.5. This channel, denoted here as Channel 1, is the oldest and most established relationship between the patient and the health care provider. Within this channel, the patient provides information to her health care provider and receives feedback, advice, and a treatment plan.

## *3.2 Scenario 2: Health Care Providers Utilizing EHR Systems*

Implementation of EHR systems with patient portals established at least one, and possibly two, additional communication channels, as illustrated in Fig. 8.6. In communication Channel 2, the clinician enters data into the EHR system, and views data stored in the system. The EHR system may also provide information about relevant treatment guidelines and reminders relevant to specific patient care.

### 3.2.1 Channel 2: Providers and the Database

Implementation of EHR systems generated initial concerns about the impact of this technology on the quality of communications occurring in Channel 1. Clinicians were concerned that time spent sending and receiving information on Channel 2 during visits would restrict the time available for communicating with patients on

**Fig. 8.5** Patient and provider communicate through channel 1

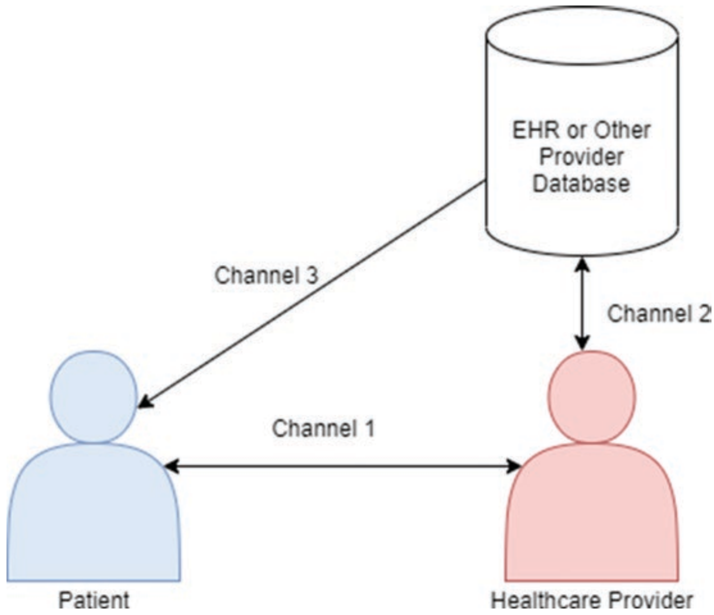


**Fig. 8.6** Communication channels through an EHR system

Channel 1. Over time, clinicians and provider organizations have modified workflow patterns to address this issue. For example, some provider organizations use team care models in which medical assistants handle some of the channel 2 communications. (See Chap. 5 for a discussion of issues posed by implementation of EHR systems.)

### 3.2.2 Channel 3: Patients and the Provider Database

Some provider organizations also implemented patient portals that allow patients to view information stored in the EHR system. In this situation, a third communication channel of information operates between the patient and the EHR system (denoted here as Channel 3). Providing patient access to this data facilitates development of more informed patients and can improve the quality of communication in channel 1. This channel is typically managed by a web portal that grants patients access to information relevant to their treatment, such as lab test results and the status of medication prescriptions. A more thorough discussion of the legal, technological, and ethical environment of patient access to data is available in Chap. 5 of this book.

## *3.3 Scenario 3: Health Care Providers Utilize EHR Systems and Patients Communicate with Providers via Telehealth*

When patients use telehealth to communicate with their established providers, the communication channel structure illustrated in Fig. 8.6 remains unchanged. However, clinicians face questions about the types of data that will be allowed to flow through Channel 3 such as:

- Will patients be permitted to view recordings of the telehealth sessions stored in the EHR database?
- Will patients be permitted to record the sessions as they occur?
- Will patients be permitted to view the clinician's session notes?

## *3.4 Scenario 4: Health Care Providers Utilize EHR Systems and Patients Utilize Mobile Apps, Self-Diagnostic Tools, and Monitoring Devices: Provider Organization Does Not Integrate the New Types of Information into the EHR System*

Clinicians face additional strategic options regarding the channel structure when patients begin using new technologies such as mobile health apps, self-diagnostic tools, and monitoring devices. The provider organization may, or may not, elect to integrate information generated by patient use of these new technologies into the health care setting and into the EHR system. If the provider organization elects to utilize this information during patient visits without integrating the information into the EHR system, the communication channels would be structured as shown in Fig. 8.7.

In this scenario, patient-generated data is not uploaded from the app or mobile device to the provider's EHR system. Therefore, the EHR system is not affected by patient decisions to use the new technologies. Instead, the patient communicates with the health app through the new Channel 4, and the patient communicates with the provider through Channel 1. The patient and provider might jointly examine data generated by the app during visits, but this data is not stored on a provider database. While information generated by the patient's use of the mobile app could strengthen communications in Channel 1, it is also possible that patient difficulties using the app could distract from useful communications in that Channel. This subsection discusses potential impacts of the mobile app on Channel 1 communications, and then it discusses issues relevant to Channel 4.

### 3.4.1 How Channel 1 Is Affected by Technology

In the context of a technologically integrated environment, this channel provides an opportunity for patients to supplement their communications with clinicians by sharing information. For example, if a medication tracking application shows that a

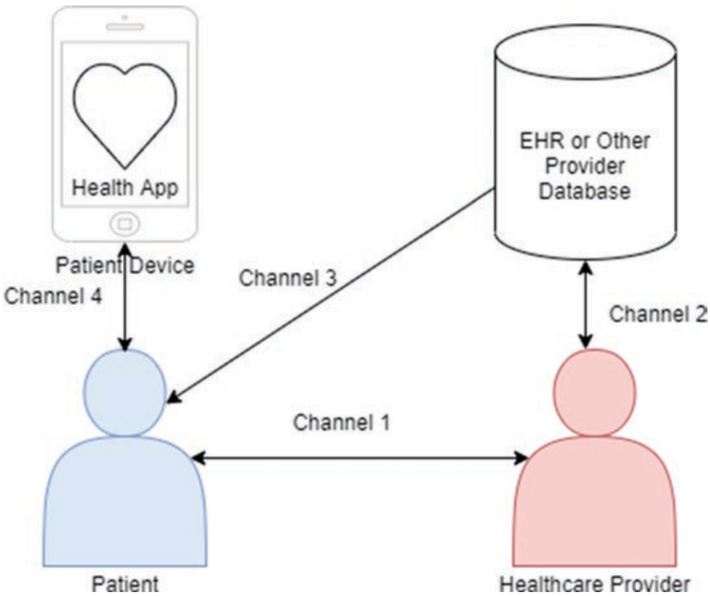


**Fig. 8.7** Patient device and health application

patient consistently misses timely doses every Wednesday and Thursday, then channel 1 is where more information can be gathered as to why that is the case.

Integration of technology also changes the typical flow of channel 1. If patients are unable to complete a task on their device, or if they are confused by some aspect of it, then they may need to speak with their health care provider to gain a better understanding of functionalities. Patients need to have a resource in case the help-systems built into the application are unable to address their concerns. Realistically, clinicians are not expected to provide patient support in this regard. Other members of the health care staff could be trained to handle patient requests for IT support, and clinicians can direct patients to this source of assistance, to ensure an orderly integration of systems and transfer of information through channel 1. Ideally, the application provides problem solving steps that users can follow to diagnose common questions or problems. However, if patients still have trouble, successful integration of a technological intervention requires a clear line of communication by which patients can receive help. Recommending a single mobile health application to patients will streamline the effort required to help patients learn how to use the app. With one external channel, responses to data problems and patient concerns can be more standardized and efficient.

Channel 1 provides an opportunity for the health care provider to demonstrate to the patient how to properly access functionality or correctly perform a task such as input data. Within this channel, patients can also communicate the positives from their experiences utilizing an application and potentially generate a source of additional support for their care. To ensure effective communication in this channel, health care providers should be aware of the application's functionalities and the steps to access these. If patients are able to receive the support they need in a timely manner within channel 1, then the data that can be generated from other channels will improve in quality.

### 3.4.2 Channel 4: Patients and Their Devices

Channel 4 can generate new types of information that can potentially strengthen communications occurring through Channel 1, but it can also potentially distract from important Channel 1 communications if patients have difficulty using the new technology or if providers have difficulty interpreting information provided by the app. This latter problem could occur if patients use an assortment of apps that generate disparate types of information in an array of app-specific formats.

Therefore, provider organizations face two preliminary strategic questions:

- Will clinicians recommend that patients use a single app for each clinically relevant situation? For example, clinicians might recommend a specific app for patients dealing with depression and a different app for patients dealing with PTSD.
- Will the provider organization provide tech support for patients learning to use the recommended apps, and – if so – how will this support be organized and funded?

Patients utilizing a health care application to supplement their care within this system are ideally doing so at the behest of their health care provider. Channel 4 indicates the flow of data between the patient and the application present on her mobile device. Considerations of this channel relate primarily to the planned function of the application and more broadly to the patient's ability to utilize technology. The three goals of this channel are as follows:

1. Accurate, timely data are supplied by a patient.
2. The patient continues to utilize the application.
3. Accurate, timely data are reported back to the patient.

If clinicians will suggest that patients use mobile apps, it may be useful to also provide guidance to help patients select apps with design features that will support achievement of these goals. To achieve goal 1, patients need to first learn how to utilize the application. Any mobile application that will be recommended to patients should account for the average demographic characteristics of potential users. For instance, if a mobile application will be used primarily by elderly individuals (65 and older), or by patients with limited sight or hearing, the application should account for these issues to maximize the app's usability. Research indicates that people exposed to mobile technologies consistently over a period of time are less likely to encounter difficulties pertaining to mobile application usage, particularly if the exposure occurred before the age of 18 (Kerr et al., 2018).

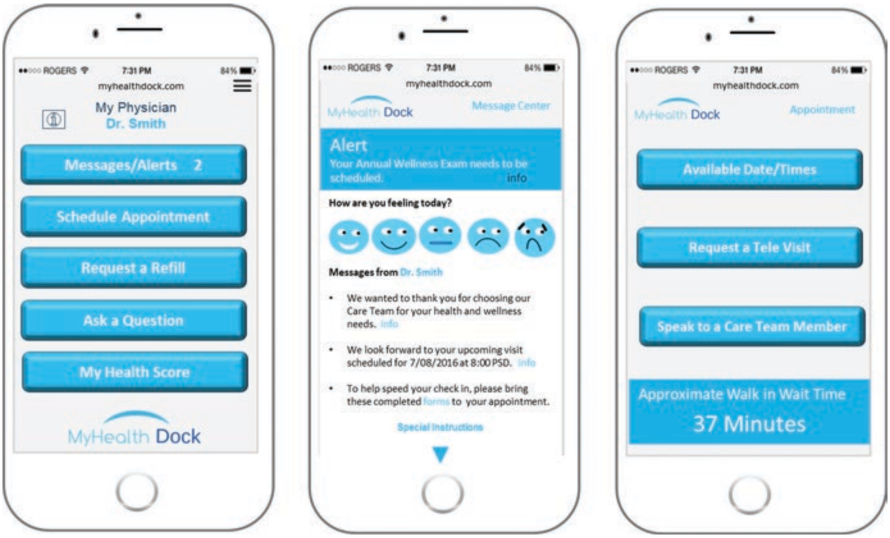


**Fig. 8.8** Mockup screens from a patient-facing health care application

Independent of demographic factors, research identifies three key features that improve user experience when utilizing mobile applications: clear screen progression, use of visual information over textual, and clear distinctions between interactive and non-interactive elements (Holzinger & Errath, 2007; Salim et al., 2017). Figure 8.8 contains a mockup of sample screens from a health care application that follows these principles.

The progressions of the screens start on the left and move toward the right. The opening (leftmost) screen displays critical information right away: it identifies the patient's clinician and offers access to five key features via five central buttons. Additional selections are available through the dropdown menu on the upper right corner of the screen. The middle screen is opened when the "messages/alerts" button is selected. The middle screen allows the patient to indicate her health status by selecting one of the facial pictographs. Further information is available to the patient through the "info" links at the end of the bullet points. The text itself is summarized to limit the total amount of information presented at one time. This selective information display gives users the option to select what they wish to read. The rightmost screen is the scheduling screen which can be reached by selecting the "schedule appointment" button on the leftmost screen. The scheduling screen allows patients to schedule an in-person or tele-visit and provides an estimate of the approximate wait time. Throughout the application, the buttons are clearly labeled in contrast to the neutral backdrop. Important information is indicated either through visual representations or by large blocks of text. And the functionalities of each screen and interactive elements are clear. The application screens demonstrate how good design can encourage the flow of information in channel 4.

Additional functionality can be integrated into a system depending on contextual needs of a health care environment. Examples would include large selection areas when entering in information, context sensitive buttons that change displays, drop-down lists with preset selections over open text boxes, or the use of videos to demonstrate tasks or exercises over paragraphs of text.

Goal 2 is continued usage of a mobile health application. For most mobile health apps, the value provided by channel 4 depends on ongoing patient use of the application. The full effectiveness of the application is lost if accurate, timely data are generated at a single point in time, but this is not followed by an ongoing stream of such data. To encourage usage, patients should be made aware of the value of what they are doing every time they utilize the application. Health care providers can reinforce this point. In addition, the application can be designed to provide ongoing reinforcement. Aesthetically pleasing designs, features that boost usability, and even reward elements such as progress bars or achievement recognitions can help patients derive additional extrinsic motivation to continue entering in information into an application. Timely data reported back to the patient also leads to goal number three. A common problem of achieving this goal is keeping patients motivated to continue utilizing the application after the initial novelty period of a new technology has worn off. This novelty period typically lasts between 2 and 4 weeks for mobile applications and wearables (Dinh-Le et al., 2019; Shin et al., 2019). Reinforcement of the benefits of the applications through channel 1 can help patients continue to enter in data to improve the quality of data passing through channel 4.

Providing information back to the patient is goal 3 of channel 4. Over a period of continuous usage, patients should be able to review the information they have supplied and ideally see visualizations of their health progress. Visualization of progress and, ideally, improvements will result in patients becoming less dependent on extrinsic motivators and gradually make the shift to intrinsic motivation (Osborn & Egede, 2010). Once patients have reached this stage, their usage rate and the accuracy of the data that they enter increases and their attrition rate decreases (Mihelj et al., 2012).

In this scenario, there is no integration between the provider database and the mobile health intervention; hence the patient's device's local storage or a third-party database becomes the repository for the patient's data. If data will be stored on the patient's hardware (e.g., cell phone or other device), storage capacity may be a relevant issue. If the patient's data will be stored in cloud-based database, then the patient's ability to connect to the Internet may be a relevant issue.

## *3.5 Criteria for Evaluating Mobile Health Applications*

Clinicians or practice organizations may decide to recommend that patients use a single mobile health app to address each specific patient health issue (such as medication adherence). This strategy can streamline the level of effort required for the health care provider to ensure that use of the app strengthens patient care experiences and patient health outcomes. However, provider organizations implementing this strategy will face the task of evaluating apps in order to select the apps that will be recommended.

Although still evolving, mHealth applications provide patients with support and coping tools, to achieve individual goals and improve efficacy and outcomes. Before implementing a mobile health intervention, however, attention should be paid to the regulatory environment and current guidelines for evaluating mobile health apps. Evidence suggests that a high proportion of mobile health apps do not meet patient and provider expectations.

The Food and Drug Administration (FDA) is one source of guidance on evaluation of mobile health devices and application. As of September 27, 2019, the FDA has categorized mobile health applications into two groups, those definitely subject to oversight by the FDA, and those subject to discretionary oversight, in which the FDA decides on a case-by-case basis whether the app will be subject to oversight. Discretionary oversight is a broad category that is reserved for applications that pose a low risk to patients (see Table 8.3). The main criteria for classifying an app as "subject to oversight" or "discretionary oversight" focuses on the degree to which the FDA assessment indicates that failure of the application would put patients at significant risk of harm (Gruessner, 2015; Sekaran, 2020).

Table 8.3 contains a list of software functions and their current classifications by the FDA (US Food and Drug Administration, 2019). Devices that control medical data, devices that interface with other medical devices directly, and software that provides diagnostic information are subject to oversight. Most mobile health applications fall underneath the category of discretionary oversight.

The FDA acknowledges within the guidance document that the field of mobile health is ever-changing and definitions, along with uses of devices and software, are subject to change. Before implementation of any mobile devices into a health care system, a review of FDA guidelines based on the functionality of the to-be system should be conducted. Mobile health platforms that are registered with the FDA are

**Table 8.3** Mobile health devices and software subject to FDA regulatory oversight

| Oversight category | Type of software (list is not exhaustive) |
|---|---|
| Subject to oversight | Extensions of medical devices that can control or analyze medical data |
| | Software that transforms a mobile platform into a regulated medical device using additional external hardware |
| | Software that performs patient-specific analysis and provides patient-specific diagnosis or treatment recommendations |
| Discretionary oversight | Software that provides supplemental information related to treatment |
| | Software functions that provide access to health information |
| | Software that assists patients in communicating with health care providers |
| | Software that performs calculations routinely used in clinical practice |
| | Software that recommends behavioral coping skills for diagnosed psychiatric conditions |
| | Software that provides checklists of common signs and symptoms to facilitate care |

not necessarily subject to oversight. Prudent health care managers will smooth new implementations by ensuring that the functionalities of proposed mobile health interventions meet the needs of the health care mission and are consistent with FDA guidelines. FDA guidelines and policies are likely to evolve over time. As of this writing, FDA policy is reported in a 2019 document titled *Policy for Device Software Functions and Mobile Medical Applications Guidance for Industry and Food and Drug Administration Staff* (https://www.fda.gov/media/80958/download).

Numerous criteria for evaluation of mobile health applications have been suggested, with no official standard criteria in place that is followed by most developers or evaluators (Dick et al., 2020). HIMMS is an organization that has sought to establish standards in health care data and has presented guidelines pertaining to mobile apps in partnership with Xcertia (2019). These guidelines are consistent with literature on this subject. In addition, this literature indicates that commonalities exist between the HIMMS/XCertia criteria and evaluation criteria proposed by other analysts and entities (Robeznieks, 2019). A compilation of three meta-studies on establishing criteria to evaluate mobile health interventions along with recommendations by the mobile health standards and guidelines body Xcertia, supported by the Health care Information Management Systems Society (HIMMS) is presented in Table 8.4.

A review of these criteria shows that there are three metrics included consistently throughout the sets of evaluation criteria: the *reliability* of the mobile health intervention, the *security* of the data being transferred by the application, and the *usability* of the tool. Studies may differ in terminology or expand on one of the three categories in more elaborate detail, such as aesthetics, networking capacities, and runtime efficiency. However, existing evaluations in the field of mobile health adhere consistently to these three metrics. As the field grows, more metrics of interest will be added and analyzed. However, independent of other developments, the three core criteria will remain a determinant of the potential efficacy of mobile health interventions.

Another ratings system in the mobile health literature is the Mobile Application Rating Scale (MARS) developed in 2016 (Stoyanov et al., 2016). The rating system ranks applications on a scale of 1–5 (5 being highest) and is a popular standard by which academic studies classify the design efficacy of mobile health interventions. Example studies utilize the MARS system to rank applications across four

**Table 8.4** Studies and recommendations on mobile health evaluation

| Publication | Criteria |
|---|---|
| Nouri et al. (2018) | Design; Information/Content; Usability; Functionality; Ethical Issues; Security and Privacy; User-Perceived Value |
| Aungst et al. (2014) | Usefulness; Accuracy; Authority; Objectivity; Timeliness; Functionality; Design; Security |
| Llorens-Vernet and Miró (2020) | Usability; Privacy; Security; Suitability; Transparency; Safety; Support; Reliability |
| Xcertia (2019) | Privacy; Security; Operability; Usability; Content |
| Stoyanov et al. (2016) | Engagement; Functionality; Aesthetics; Information |

categories: Engagement, Functionality, Aesthetics, and Information on a scale of 1–5 across a variety of mobile interventions for conditions such as back pain, heart disease, and more (Escriche-Escuder et al., 2020; Knitza et al., 2019).

Commercial applications on app marketplaces will often have user reviews that can serve as an indicator for the reliability and usability facets of the app. For a more thorough examination of an app, the MARS scale or Xcertia recommendations can be applied to determine the functionality of the data side of the application. As an evolving field, new standards for evaluation are being developed and new guidelines are being established as both software and hardware become more advanced

### *3.6 Scenario 5: Health Care Providers Utilize EHR Systems and Patients Utilize Mobile Apps, Self-Diagnostic Tools and Monitoring Devices: Provider Organization Integrates the New Types of Information into the EHR System*

In this scenario, the provider organization implements a fully integrated mobile health system, as illustrated in Fig. 8.9. The diagram shows a setting with four components: the patient, the provider, the patient's mobile computing device, and a provider database. The flow of data and communication (the channels) between the four items within this system are the basis for the following discussion.

In this scenario, the patient's mobile health device sends data to the provider's EHR. The following descriptions assume a fully integrated system wherein the mobile health app utilized by the patient is connected to the provider's EHR and five channels of communication work to support patient care.

Successful implementation of mobile health systems can potentially generate additional benefits. Long-term services and supports and other health care activities conducted by patients and family caregivers can be tracked, and data generated by these care activities can be integrated into the EHR system.[4] These new flows of information can then be utilized to provide relevant feedback to both patients and providers within the technologically enabled health care system. In addition, clinicians can use the information to make timely and informed decisions on care plans.

The decision to integrate data generated through the mobile app into the EHR system can potentially strengthen Channel 1 if the patient consistently enters data into the app, and if frequent communication occurs between patient and provider about the data being stored in the EHR. The decision to integrate can also potentially strengthen the information provided in channel 2 if the EHR system uses the app data to generate useful information to the clinician. Given the potential value of the app data, the provider organization's decision to implement a fully integrated system raises two strategic questions:

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[4] See Chap. 5 (Using Computer Technology to Support Clinical Decision Making) for additional discussion of EHR systems and issues posed by patient-generated data and behavioral health data.

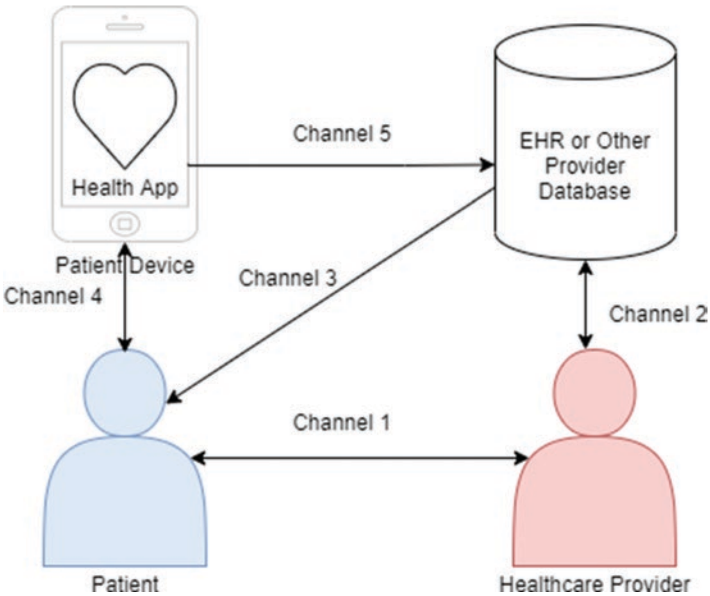


**Fig. 8.9** Patient-provider-application data flows in an integrated care setting

- How will the system be designed to ensure that patient-generated data stored by the provider is accurate?
- How will the system report patient-generated data to clinicians? What level of detail and what formats will be useful during a patient visit?

The first question focuses on Channel 5, and the second question focuses on channel 2.

### 3.6.1 Channel 5: Patient Device and the Provider Database

In channel 5, data generated by the patient are received by the provider's EHR system. Since provider databases are varied, there are many ways for this implementation to occur. When mobile technology data are received and stored by the provider's EHR, this link is typically creating in conjunction with existing health software providers such as Epic, eClinicalWorks, Cerner, or WebPT (Abdolkhani et al., 2019). Examples include integration of existing health care applications into EHR systems, or the creation of new applications along with customized databases to support the new flow of patient data (Dinh-Le et al., 2019; Genes et al., 2018).

New considerations arise if the decision is made to integrate the mobile application with an existing database. Modern networking technology allows for synchronous uploading of data seconds after the user enters it. In theory, if patient data were generated and recorded perfectly, then synchronous connectivity to the EHR would be ideal. However, data collection and transfer is an error-prone process. Having some form of verification system in place can help to alleviate some of these problems. The inclusion of a “delete” or “edit” function for patients can also help alleviate erroneous entries. However, if these functionalities are included, application security becomes a chief concern and some form of verification is needed to ensure that patients or other authorized individuals are the only people editing health records. Most systems will design channel 5 as a one-way transfer of data, meaning that patients can only upload new records to an EHR. However, if patients are permitted to access or modify additional records present in the EHR, stringent security measures will be required to ensure that data breaches do not occur. Channel 4 is where determinants of security and reliability of mobile health information systems primarily take place. Hardware considerations at this stage are also a factor. Depending on how a system is designed, patients may enter information while they are not connected to a network. Once they are connected, that information may then be delayed before sending. Considerations in this channel are data requirements, network connectivity, and the usage of data timestamps to ensure that accurate information is being passed throughout the system.

### 3.6.2 Channel 2: Using the App Data to Generate Useful Information for Clinicians

In channel 2, the information gathered from treatment of the patient is stored in the provider’s EHR and relayed back to the health care provider. If a health app is integrated with a health care provider’s system, then it is likely being presented to clinicians as a screen within the EHR. Two important considerations need to be addressed at this stage: (1) The information within the EHR must be accurate; and (2) it needs to be communicated to the health care provider in a useful format. In addition, advances in the field of artificial intelligence can help to detect patterns that may indicate an underlying health problem for a patient that has yet to emerge (Hamet & Tremblay, 2017).

In addition, the advancement of mobile health has occurred in parallel with advances in database management and artificial intelligence. These developments can address the fact that most clinicians would probably not enjoy sorting through raw data from an excel spreadsheet to check on the patient’s progress in implementing recommended self-care regimens. While such interfaces exist, most individuals, even if they are subject matter experts, desire more efficient presentations and can make faster decisions if they receive organized recommendations rather than raw data. Visualization of information and clear narrative threads across the data are important for continued and effective usage of a new technology (Munzner, 2014). Integration with existing electronic medical record systems and health care portals and software can limit the difficulties associated with implementation of a new system. Recommending a single mobile health intervention to patients will streamline the process of integrating the mobile health data into the EHR system and providing useful summary information to clinicians.

A proactive manager of these changes will consider the following:

1. The data functionalities of the applications recommended for integration
2. Where the data go
3. The readability of the data
4. How data can be integrated and used in the wider system

The vision of a fully integrated solution includes permitting patients to upload app-generated data and patient-generated data into the EHR system, and then providing useful summaries and visualizations of this data to clinicians. Current EHR systems were not initially designed to perform these functions. Recently, some health care systems and IT system providers are working to address these issues. For example, the company *Innovaccer* offers an EHR system that integrates traditional health care data with behavioral health data, mobile health app data and telehealth capabilities.

Innovaccer is actively addressing issues often raised by individuals working with EHRs. The Innovaccer software platform can integrate several types of data into EHRs, including behavioral health data and data generated from mobile sources. The platform also expands the definition of the health care team to be supported by EHR communications, by allowing for timely information flow to long-term patient support and maintenance caregivers. The data being transferred throughout the systems can then be used to improve patient outcomes. For example, an individual caring for an elderly family member may receive an alert on her phone when that elderly family member has travelled over 50 feet from his home location. This information can then be acted on immediately to ensure that the family member is safe, and relevant information about the event can be recorded for future analysis.

The Innovacer technologies offer the potential to help address limitations of current EHR systems by improving data transformation, decision support, and team-based care by ensuring that team members have ready access to relevant information, including information relevant to the clinical psychologist. Innovaccer is just one of many companies that are capturing the opportunities generated by the growth of information technology in health care.

## 4 Conclusion

Patient use of mobile devices and mobile applications is increasing. However, the quality of these devices and apps varies. App characteristics that determine their usability, data integrity, and information transparency will determine the success of individual apps.

Some clinicians and some provider organizations are developing strategies for utilizing these apps in clinical settings, to strengthen patient engagement, support behavioral change, and help patients manage chronic conditions. Integrated platforms can import information generated as patients use mobile apps and devices, store the data, and support communication of relevant information between patients and care team members. However, achieving successful integration of information generated by self-diagnostic tools, mobile apps, and telehealth into clinician workflows is not a simple task. Analysis of the structure of communication channels and flows of information through these channels provides a framework for examining strategic options.

As clinicians and provider organizations work to help patients by maximizing the benefits and minimizing the harms of new types of data and communications, they face substantive strategic issues. Health care provider organizations implementing telehealth face a series of strategic questions:

- What information is needed prior to the telehealth visit?
- Will patients be permitted to view recordings of the telehealth sessions stored in the EHR database?
- Will patients be permitted to record the sessions as they occur?
- How will visit reports be generated and shared?
- Will patients be permitted to view the clinician's session notes?

Health care provider organizations considering patient use of mobile apps and devices, and online self-diagnostic tools, face additional questions, including:

- Will clinicians recommend that patients use a single app for each clinically relevant situation (e.g., will clinicians recommend a specific app for patients dealing with depression and a different app for patients dealing with PTSD)? If so, how will these apps be identified and selected? How will these recommendations be updated over time?
- Will the provider organization provide tech support for patients learning to use the recommended apps? If so – how will this support be organized and funded?
- Will patients be permitted to upload app-generated data to the provider organization's EHR system?
  - How will the system be designed to ensure that patient-generated data stored by the provider is accurate?
  - How will the system report patient-generated data to clinicians? What level of detail and what formats will clinicians use to support provider decisions and strengthen communications with patients?

Developing successful strategies for harnessing the benefits offered by these new technologies will require detailed collaboration between the practice organization's Information Technology (IT) professionals and the clinicians who use the organization's EHR system. As the technology continues to advance, the clinical psychologist can play a valuable role by working closely with technology development teams. The psychologist's knowledge and experience will help shape and improve medical technology solutions, which will advance the landscape of population health and patient-centered medical care. Clinicians will fill three roles:

- Clinicians will assess whether specific technologies are likely to be useful for specific patients: Would a virtual cat help a patient manage anxiety? Would a robot be an appropriate monitoring and reminder device?

– To support these decisions, clinicians will also help design studies to evaluate patient satisfaction and outcomes generated by emerging mobile apps and devices.
– Clinicians will work with technology developers and with their organization's IT professionals to specify useful types of app-generated information, useful formats for presenting summarized information to patients and clinicians, and useful types of decision-support tools and automated communications.

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