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The emerging story of emerging technologies in neuropsychiatry

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Introduction

By the time this review reaches publication, most of its content will be obsolete. The development and penetration of new health-related technologies is occurring at a breakneck pace, leaving no part of the health care environment untouched. There are technologies emerging every day for patients and their families, for researchers and educators, for providers and payers, and for health care organizations and even retail corporations. Indeed, the pace at which new technologies are being developed far surpasses the pace of scientific investigation into the safety, efficacy, and cost-effectiveness of their clinical applications. And therein lies the power—and the challenge—of emerging technology in modern medicine. That is to say, the most immediate impact of today’s rapidly developing health-related technology is not on cures for diseases, but on health care delivery.

Two common examples of emerging technology are mobile software applications (“apps”) and wearable technologies (“wearables”). Each of these technologies currently has more application in the areas of health assessment and monitoring than in therapeutics. Mobile apps are computer programs designed to help users perform specific tasks. They run on mobile devices such as smartphones or tablet computers, and come preinstalled on, or can be downloaded to, these devices. Apps first began appearing in 2008, and since that time, development and penetration have increased exponentially.

The growth of new technologies in health care is exponential, and the impact of such rapid technological innovation on health care delivery is substantial. This review describes two emerging technologies—mobile applications and wearable technologies—and uses a virtual case report to illustrate the impact of currently available technologies on the health care experience of a patient with neuropsychiatric illness.

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By the end of 2012, over 91% of the US population had a cell phone,¹ and over half of the world's population now has a mobile connection.² mHealth apps are mobile applications designed to improve health outcomes, deliver health care services, or enable health research.³ There are over 40 000 health-related apps currently available, about 6% of which target mental health outcomes, with another 18% targeting mental health-related issues, such as stress, relaxation, and sleep.⁴ Research suggests that both the general public⁴ and patients receiving mental health care services⁵ are quite amenable to using mobile technologies such as apps for various aspects of mental health care, including symptom monitoring and self-management.

The current evidence base for apps is small and consists of studies with small sample sizes. A recent systematic review found that the vast majority of published literature on mental health apps provides descriptions of apps or their various technical features, but does not include controlled outcome data.⁴ The same review identified five mental health apps that have been evaluated in eight randomized controlled trials: three involved subjects with depression, three involved subjects with “stress,” one involved subjects with anxiety and depression, and one involved subjects with substance use and borderline personality disorder. Another systematic review identified five studies evaluating smoking cessation and three evaluating anxiety.⁶ Two other studies evaluated apps used for managing bipolar disorder or schizophrenia⁷ and “mild-to-moderate stress, anxiety, and depression.”⁸ Taken together, the results of these studies show statistically significant reductions in symptoms, albeit with modest effect sizes.

The promise of apps for mental health care delivery is huge. The demand for mental health care services, as well as the growth in that demand, continues to outstrip the health care system's ability to supply those services effectively and affordably, particularly in low- and middle-income areas.⁹ Mobile technologies have huge potential to improve upon labor shortfalls and other workforce inefficiencies. For example, researchers estimate that, while there are only 10.3 mental health care providers per 100 000 people worldwide, there are approximately 85 473 mobile phone subscriptions per 100 000 people.¹⁰ This basic math calls attention to the fact that mobile phone apps represent a communication opportunity of global magnitude that could dramatically increase access to mental health care services. Given

this potential, it is not at all surprising that the development of mental health apps is thriving despite the fact that substantially more research is needed.

Wearable technologies, or “wearables,” are interactive digital devices that monitor the user's behavior and physiology. Common examples include smartwatches (eg, Apple Watch) and activity trackers (eg, Fitbit), both worn on the wrist. Other less common examples are worn on the face (eg, Google Glass) or in the user's clothing. All these devices are rich with sensors that can monitor and collect user data, such as motor activity, sleep quality and quantity, and markers of stress or attention. Some data are gathered passively (eg, heart rate or hours of sleep), while others require user interaction (eg, self-reported mood states at certain points in time).

Potential clinical applications abound for wearable technologies, particularly when combined with mobile apps that analyze user data and, in some cases, offer interventions. For example, logs of accelerometer or geolocation data can provide a clinician with a picture of a person's activity level. In similar fashion, sleep logs can provide a characterization of a person's sleep quality that has the potential to be more accurate in some ways than the person's own self-report. Some researchers are using these types of data to define new measures of mental health,^{11,12} and others are investigating ways wearable technology can improve the care of individuals with Parkinson disease, such as to reduce fall risk or “freezing.”¹³ Commercial applications for wearables tend to offer interventions that are advertised to be therapeutic or helpful in some way. For example, some wearable devices monitor respiratory rates or patterns and then synchronize with the user's smartphone to send notifications of high stress levels or to suggest calming interventions like deep breathing. There is even a wearable that promises to monitor and improve the user's posture over time.

As is the case with apps, the challenge for clinicians and patients is that the commercial development of wearables far outpaces the science. Today, less than 2% of people in the US have a wearable device, but this is not stopping the exponential growth of this multi-billion-dollar industry.¹⁴ A large amount of this growth is in the health care industry, where products like the Apple Watch are being explored by numerous health care organizations as “the next big thing,” despite the paucity of scientific evidence supporting their effectiveness as drivers of behavioral change. Some experts urge

caution, arguing that for wearables to deliver on their promise to improve health behavior, they must be able to create new habits that are durable or to sustain the external motivation to wear them.¹⁵

The virtual case report below is designed to highlight various applications of new technology in clinical neuropsychiatry. There are, of course, many other forms of emerging technology—from robotics and artificial intelligence to synthetic biology and affective computing. Although the case report makes reference to some of these, the primary focus is on apps and wearables. Each of the technologies mentioned currently exists.

Case report

Mr Tech is a married 68-year-old right-handed man who recently retired from a career as an accountant. He has a history of hypertension, hyperlipidemia, gout, seasonal allergic rhinitis, alcohol abuse, and benign prostatic hypertrophy. He has been hoping to spend his retirement playing golf, but over the last 6 months he has noticed a tremor developing in his right hand. Over the last 3 to 4 weeks, he has noticed his golf game start to deteriorate because of the tremor. Therefore, he has resolved to “do something about it.”

Mr Tech’s first encounter with the modern health care system begins at the country club café after a round of golf. While waiting for his lunch order to arrive, he pulls out his smartphone and types “hand tremor” into the YouTube app. The search yields over 48 000 results. (For the search term “seizure,” there are over 745 000 results.) He spends the next 15 minutes watching short videos, many homemade, on a range of topics, including essential tremor, stress, caffeinated beverages, Parkinson disease, multiple sclerosis, and techno music. He also comes across various tips, tricks, and remedies to mollify the tremor. The list of possible medical explanations for his tremor seems longer than he expected, and some of the videos leave him feeling overwhelmed and even a bit frightened. He shuts off his smartphone and slips it into his pocket.

Upon returning home, he finds himself unable to stop fretting over his experience at the clubhouse. He opens his laptop and decides to search for a “more legitimate” medical Web site to help him understand his symptoms. What he finds is in some ways more distressing because the Web sites contain clinical jargon that he does not fully understand—words like “dystonia,” “bra-

dykinesia,” and “optogenetics.” Despite his distress, and his wife’s resultant insistence to “get off the computer” he spends the next 2 weeks compulsively consulting Web site after Web site that could possibly have anything to do with his symptoms.

He becomes more active on social media Web sites and joins Facebook groups related to essential tremor, living with dystonia, putting up with Parkinson disease, and fundraising for amyotrophic lateral sclerosis. Through a number of online interactions with peers, he becomes progressively more convinced—and concerned—that he has Parkinson disease. He downloads an app that scores his performance on motor tasks involving the smartphone screen, like finger tapping and drawing an Archimedean spiral using his finger.

He also comes across a TED Talk in which applied mathematician Ted Little describes a new and inexpensive technology that is able to detect Parkinson disease through simple voice recordings obtained over the telephone. The Parkinson Voice Initiative (PVI) has obtained over 18 000 recordings that he and his team are studying with precise voice analysis. The technology identifies patterns in the human voice that reflect the opening and closing of the vocal folds, thus enabling clinicians to detect Parkinson disease accurately and in its very early stages. After viewing the TED Talk, Mr Tech immediately places a call to the PVI and volunteers to provide a recorded sample of his own voice.

By the end of the golf season, Mr Tech finds that he is no longer able to write legible numbers on his golf scorecards. His legs and back feel stiffer, and the tremor has moved into his left hand in addition to the right. A Facebook friend recommends that he begin taking coenzyme Q10, so he sends his primary care clinician an electronic message through the patient portal used by the health care organization to ask if coenzyme Q10 will be safe to take with his regular prescription medications. He then deletes the message and simply logs on to a Web site that checks for drug interactions with one click of the mouse. He then types a new message to his primary care clinician that reads, “I have begun taking coQ10. Just wanted you to know. I think I have Parkinson disease.” The automatic reply that he receives feels sterile and impersonal. It reads, “Thank you for your message. If this is an emergency, please call 911.” This electronic exchange, 6 months into the development of his symptoms, represents the first interaction Mr Tech has with the traditional health care system.

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After a few weeks of taking coenzyme Q10, Mr Tech notices little change and decides he needs to see a specialist. Rather than asking his primary care clinician for a referral, he pulls out his smartphone and uses the Healthgrades app to search for local physicians that specialize in Parkinson disease. He sorts through the search results using filters for patient satisfaction, experience, and proximity. His top choice is a neurologist whose profile lists an address and phone number, but his second choice is a different neurologist whose profile allows him to schedule an appointment directly from the Web site. This neurologist is out of his insurance network, but Mr Tech is willing to pay a larger amount out of pocket in order to be seen right away. He goes with his second choice.

A moment or two after scheduling his initial appointment, he receives a notification on his smartphone that his new neurologist has sent him an email. The email contains suggestions on how to prepare for the visit, including how to download his personal health records using Blue Button. As a Medicare beneficiary, Mr Tech is able to download the last few years of his personal health information onto his smartphone in a format that is easy to share with others. Once the file is downloaded, he uploads it directly to the Web site of his new neurologist for review prior to his appointment. Having done this before with his rheumatologist, Mr Tech recalls that it is wise also to print out a paper copy of his health records to bring to the appointment, just in case the neurologist's team encounters "technical problems."

The email from the neurologist also contains a link to an interactive self-assessment for Mr Tech to complete online prior to coming in for the initial visit. The neurologist's team created the self-assessment tool for new patients based on content in the Parkinson's Toolkit, an online resource developed by the National Parkinson Foundation and easily accessible through an app on his smartphone. Mr Tech finds this online self-assessment less user-friendly than Web sites he commonly uses to access social media or news headlines. He quits the assessment and, that weekend, enlists his teenage grandson for assistance. His grandson quickly loses patience with the online assessment and quips, "It would just be easier for you to show the doctor the videos from your birthday party last year where you're moving around normally. They're on my Instagram feed. What's the neurologist's Instagram handle?" Mr Jones does not

understand this question, but his grandson nevertheless helps him send a copy of the video to the neurologist via email.

The following morning Mr Tech and his wife arrive at the neurologist's office for his consultation. They had no trouble locating the clinic with the assistance of Wayz, a mobile application that uses global positioning system (GPS) navigation to provide driving directions and traffic patterns. After checking in for his appointment, Mr Tech pays for the consultation using the ApplePay app on his smartphone. He then spends a few minutes with a team of two nurses, one who administers the Unified Parkinson Disease Rating Scale, and the other who films the exam using her smartphone and then uploads the video to Mr Tech's electronic health record.

The neurologist, having reviewed the video as well as all the additional information Mr Tech provided prior to the visit, enters the room and confirms the diagnosis of probable Parkinson disease. He commends Mr Tech on his level of engagement in his health and health care. Most of the visit is spent in discussion with Mr Tech and his wife, answering their questions about prognosis and considering options for treatment. The neurologist e-prescribes a dopamine agonist medication and then invites Mr Tech to document his experience taking the medication using OpenNotes, a system of shared clinical documentation that allows him to enter information directly into his own medical record.

Over the next 2 to 3 weeks, Mr Tech's wife observes a progressive change in her husband's behavior. His tremor and stiffness have improved, allowing him to get back out on the golf course. However, rather than spending 6 days a week on the golf course, he has been taking his friends to the casino and organizing poker tournaments at home. There are even some days when he goes to the casino alone. In their 35 years of marriage, she has never seen him gamble, and she becomes concerned. She begins seeking guidance from the members of a Parkinson disease support group that she has joined online. A number of people share similar stories with compulsive behaviors that were ultimately attributed to a dopamine agonist medication. Immediately alarmed, Mrs. Tech emails a transcript of her online conversations to the neurologist and tells her husband to stop taking the medication. He complies, and then completes a review of the neurologist on Healthgrades.com.

The next day he returns to the Internet to search for a different neurologist. He wants someone who is an expert in Parkinson disease, has the easy accessibility of the neurologist whom he recently saw, and will not make him “start from scratch” with providing his entire health history. Most of all, he wants someone who will help him avoid medication side effects as serious as the compulsive gambling he experienced while taking the dopamine agonist. He identifies a neurologist who is prominent in Europe for her research on treatments for Parkinson disease and who performs second-opinion consultations remotely using Skype. Using telemedicine technology, she finds it much easier to reach patients from all over the world, and her patients—many of whom are disabled from their disease—find it much easier to access her, which they can do from the comfort of their own home.

During Mr Tech’s teleconsultation, the diagnosis of probable Parkinson disease is reaffirmed, as is Mrs Tech’s diagnosis of medication-induced compulsive gambling. The neurologist recommends a trial of levodopa and agrees to contact Mr Tech’s local neurologist to discuss this recommendation. The local neurologist concurs with the plan and e-prescribes levodopa, which Mr Tech has delivered to his home by drone later that afternoon using QuiQui, a mobile application that enables people to have pharmacy items delivered to their doorstep using drones.

Over the next several weeks, Mr Tech collaborates with both neurologists to optimize the dosing regimen of levodopa. In so doing, his symptoms of parkinsonism come under good control, and he finds himself able to play a round or two of golf each week—and to stay away from the casino. The most bothersome aspect of his care is the frequency with which he has to take pills each day. Upon hearing this complaint, one of his Facebook friends who also has Parkinson disease suggests he try the formulation of levodopa he has been taking. It is synthesized using a three-dimensional printer, which allows the pharmacokinetics of the drug to be customized to an individual patient. Mr Tech finds this advanced drug formulation to be well worth the extra out-of-pocket expense given the fact that he only has to swallow one pill once a day.

Over the next year, Mr Tech settles into his retirement and, through the use of social media, learns new tips on how to adapt his golf game to his symptoms of Parkinson disease. Other than some difficulty recalling

the names of some of his golf buddies and the birthdays of his grandchildren, his mind is still sharp. He finds enjoyment in learning the science of Parkinson disease, which he does by reading open-access biomedical journals online.

Through his reading he discovers a possible explanation for the vivid dreams that have recently been waking him up in the middle of the night—REM behavior disorder (RBD). His curiosity becomes insatiable, and he purchases a number of wearable devices from Web sites in hopes of confirming his diagnostic suspicion. The first piece of wearable technology he orders is a Fitbit. During the day he wears the Fitbit to help him monitor his movement during his golf swing, and at night he wears it to monitor his sleep.

The second piece of wearable technology is a high-resolution, multichannel, portable EEG system that runs him around \$500. Although the open-access journals he has been reading have not described much evidence to support the use of neurofeedback in improving memory, he figures he might as well give it a shot. Plus, he thinks it is a good idea to be certain he is not having seizures at night. The EEG system he orders can be synchronized to various apps on his smartphone where he can perform neurofeedback exercises and store the EEG data recorded during them. His local neurologist recommends that he receive a “proper EEG here in the lab,” but Mr Tech politely declines since he has “already spent the money” on the home EEG device. Using his smartphone he sends his neurologist a copy of all the EEG and movement tracking data he has been obtaining from both the EEG device and the FitBit. The neurologist has trouble importing these data directly into Mr Tech’s electronic health record, but he has no difficulty viewing them. The data do appear to support a diagnosis of RBD, so he prescribes a benzodiazepine and instructs Mr Tech to take it at bedtime. Feeling validated, Mr Tech happily complies.

A few months later, Mrs Tech telephones the neurologist’s office to report that, although the RBD seems to have improved since her husband started taking the benzodiazepine, she is becoming increasingly concerned about his driving. She has noticed that his reaction time seems much slower and, as a result, he is not always stopping at stop signs or red lights. She wonders if he should not be driving but is afraid to make such a suggestion to her husband because he of his “stubborn independence.” The neurologist recommends that

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she and her husband visit a physical rehabilitation clinic nearby that uses simulation technology and virtual reality technology to assess and treat motor disabilities, including problems with driving and falling. Despite its extremely high cost and the fact that virtual reality technology is mainly being used to improve preventive care, the initial visit at the rehabilitation clinic is sufficiently alarming to both Mr and Mrs Tech that he agrees to stop driving.

At first Mr Tech seems discouraged but comfortable with his decision. He finds some solace in communicating with his support groups on social media, where he learns of the Rides for Parkinson's mobile app that enables him to use his smartphone to obtain free transportation anytime he needs it, especially when his wife is not available. He also learns about opportunities to participate in research, such as projects designed to accelerate data collection and discovery in the field of Parkinson disease. For example, Parkinson mPower and FoxInsight are projects (both supported by the Michael J. Fox Foundation) that combine mobile apps with wearable technology like the Apple Watch to capture data on symptoms and progression of Parkinson disease as part of a clinical study. The huge popularity of mobile devices enables the collection of such data as dexterity, balance, and gait at a pace never before achieved in traditional clinical studies.

Despite some engagement in these types of regenerative activities, Mr Tech over time grows progressively demoralized by his disabilities and diminishing independence. He begins ruminating on his "wasted retirement" and no longer desires to play golf with his friends. Not even visits from his grandchildren lift his mood. His appetite decreases, and he begins losing weight. Occasionally, during an episode of freezing, he suffers a panic attack. He begins telling his wife that he "doesn't want to live like this," at which point she insists the he "see someone."

Too embarrassed to share these thoughts and feelings with his two neurologists or physical rehabilitation team, Mr Tech searches for a technological (and, perhaps, more comfortable) solution. His effort to find a mobile app to treat his depression quickly becomes thwarted by the sheer number of search results. Among the thousands of mobile apps related to depression, anxiety, stress, relaxation, mindfulness, and other related topics, he does not even know where to begin. Furthermore, he needs guidance on which apps are "professionally recommended."

Mr Tech elects to obtain another teleconsultation, this time with a psychiatrist. The psychiatrist diagnoses him with a major depressive episode and prescribes the combination of an antidepressant medication and a course of Web-based cognitive behavior therapy (CBT). This approach provides Mr Tech with a low-cost option for psychotherapy that has easy access and a flexible schedule. Multiple randomized controlled trials support the use of Web-based CBT interventions to reduce symptoms of depression, including suicidal ideation.¹⁶ Mr Tech completes a 10-week course of CBT and finds that his major depressive episode has fully remitted. His appetite is back to normal, and he is back out on the golf course.

During a round of golf one afternoon, Mr Tech learns that one of his golf buddies who also has Parkinson disease recently underwent deep brain stimulation (DBS) surgery and received significant benefit in the motor symptoms of his disease. Mr Tech discusses the option of DBS with his wife, then with his neurologist, and a few weeks later he completes the presurgical workup and is scheduled for surgery. On the day of the operation, his wife logs in to a secure Web site where she is able to watch the entire surgery live from home using a streaming service. The neurosurgeon performs the operation without complications, the whole time wearing Google Glass,¹⁷ which allows him to produce a video record of the entire operation that serves as his clinical documentation once it is uploaded to the electronic health record.¹⁸ A few weeks later Mr Tech has the stimulators programmed, and he notices an immediate improvement in his motor symptoms. Using the DBS mobile app, Mr Jones is able to monitor the battery life of his stimulators and even receive a notification when they need to be replaced.

Over the next few years, he experiences no significant side effects from DBS, although he does suffer a progressive decline in cognitive functioning. Eventually, a full dementia syndrome sets in, and Mrs Tech has more and more difficulty caring for him in their home. Repeated bouts of disinhibited behavior are managed with sedative medication, but Mr Tech often refuses to take it. At one point, his neurologist recommends a new formulation of an antipsychotic medication (ie, arpiprazole) that has adherence monitoring built into it. This technology allows his neurologist to track exactly how much of the medication Mr Tech is actually receiving. Although this information is reliable, the medica-

tion does not have a meaningful impact on Mr and Mrs Tech's quality of life.

What eventually does make a difference, however, are two robots that Mrs Tech is able to have in their home. The first is Paro (www.parorobots.com), a seal-like robot that provides companionship, lowers stress, and even increases levels of oxytocin. Paro is very popular among the elderly in Japan. The second robot is a more anthropomorphic robot that assists with activities of daily living, including preparing meals, fetching items, and even bathing. With the help of these two robots, Mrs Tech is able to keep her promise never to place her husband in a nursing home.

During an annual visit to their family physician, Mr and Mrs Tech are asked about all the technology that has become a part of their lives. Mrs Tech smiles and says, "Well, it certainly has kept us on our toes!" Taking on a more reflective look, she goes on to say that, overall, she is not really sure if her husband's care is necessarily better or more affordable, and she laments how the doctor-patient relationship has changed in some significant ways. However, she feels confident that technology has enabled her husband to receive health care more on his terms and to remain more in control of his health care experience. Mrs Tech then receives an alert on her smartphone that she and her husband are late for their lunch date at the country club.

Conclusions

The case described above is virtual but not futuristic. All of the technology mentioned currently exists and is already in use. We have not delved into more "cutting-edge" technologies, such as artificial intelligence, affective computing, or biosynthetics, technologies that more directly question traditional notions of the self and what it means for multiple selves to interact and communicate.

What are the implications of caring for patients and their families in such a technologically integrated world? First and foremost, there are important implications for the doctor-patient relationship. While technology may impact the form of the doctor-patient relationship, it should not affect its function. For example, if a clinician's use of a smartphone app to complete an Abnormal Involuntary Movement Scale (AIMS) assessment during a visit with a patient with paranoid schizophrenia leaves the patient feeling uncomfortable or suspicious, thereby

threatening the therapeutic alliance, the clinician should address this unintended effect and consider using a different form of the tool. On the other hand, if a clinician refuses to adopt certain technology that a patient insists upon using, then that patient may seek out another provider who is willing to interact in that preferred way. The use of text messaging to access mental health care services among adolescents offers a striking example of this phenomenon.¹⁹ Technology involves users, and users are people. The presence of technology within the doctor-patient relationship may alter its shape and structure, shifting the locus of control from doctor to patient and back again, but ultimately it is up to people to determine whether or not the relationship works.

Second, health care providers and educators would do well to keep their focus on managing information rather than technology. The pace at which new technologies are being developed and introduced into health care is rapid. The implementation of practice guidelines and health policies related to such technology will always lag behind. At the point of care, patients and providers need a guiding principle to help them navigate the ever-changing and sometimes tumultuous waters of information technology. Whether a patient is using a mobile application to book an appointment, or a surgeon is using Google Glass to record a surgery, the most important outcome is whether the right information gets to the right person at the right time and in the right way. Using this "right information" principle as a filter through which to make decisions about a given technology (eg, should my practice adopt it, or should I discourage my patient from using it?) will help ensure safe use, appropriate protections, and efficient deliberation. Applied to medical education, the "right information" principle will help ensure that curricula include topics such as how to assess the scientific validity of new technologies and how to counsel patients on how to use them safely, rather than topics related to the technical aspects of specific technologies that will quickly become obsolete.

Third, research should incorporate emerging technologies in ways that improve the delivery of care. The development of a new technology is not an academic end in itself. For providers to adopt it, it must be useful, easy to use, and interoperable with other technologies.²⁰ Most importantly, we must learn whether its adoption actually improves outcomes that matter to patients. Such research is crucial to avoiding waste. For example, although

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patients generally have positive attitudes toward using patient portals, studies have not demonstrated a positive effect of such portals on outcomes that matter (eg, patient empowerment, clinical outcomes, costs).²¹

Emerging technologies can be exciting, engaging, and expensive. Patients and providers must demand

that developers create products that improve the value of the health care. Value is defined as the health outcomes that matter to patients per dollar spent.²² Setting value as “true north” will help the large and swift-moving technology ship stay headed in the right direction. □

La naciente historia de las tecnologías emergentes en neuropsiquiatría

El crecimiento de las nuevas tecnologías en la atención de salud es exponencial y el impacto de esta rápida innovación tecnológica en las prestaciones de atención médica es sustancial. Esta revisión describe dos tecnologías emergentes –las aplicaciones móviles y las tecnologías portátiles– y emplea un reporte de caso virtual para ilustrar el impacto de las tecnologías actualmente disponibles en la experiencia de la atención de salud de un paciente con patología neuropsiquiátrica.

L'histoire naissante des nouvelles technologies en neuropsychiatrie

La croissance des nouvelles technologies dans le domaine de la santé est exponentielle et l'impact d'une innovation technologique aussi rapide sur les prestations de santé est considérable. Cet article décrit deux technologies récentes, les applications mobiles et les technologies « portables », et présente une étude de cas virtuelle illustrant l'impact des technologies actuellement disponibles sur l'expérience thérapeutique d'un patient atteint d'une maladie neuropsychiatrique.

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