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Personal Activity Trackers and the Quantified Self

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ABSTRACT
Personal activity trackers are an inexpensive and easy way for people to record their physical activity and simple biometric data. As these devices have increased in availability and sophistication, their use in daily life and in medicine has grown. This column will briefly explore what these devices are, what types of data they can track, and how that data can be used. It will also discuss potential problems with trackers and how librarians can help patients and physicians manage and protect activity data. A brief list of currently available activity trackers is also included.

KEYWORDS
Activity trackers; FitBit; fitness trackers; life logging; quantified self

Introduction

Ever since "physical fitness" became something to be concerned about, people have looked for ways to quantify the amount of physical activity they perform. Runners track distances and times, weight lifters count sets and pounds lifted, and swimmers count laps; everybody is counting something. Until relatively recently, much of this counting was done manually or with simple tools like a pedometer. Recent advances in technology have created a new class of wearable devices commonly referred to as personal activity trackers or fitness trackers. These devices allow users to automatically track information about their physical activity, from steps taken to vertical distance travelled, and from heart rate to sleep cycles. These devices also make it easy for users to create detailed records of their physical activity. These records can be valuable tools in motivating users to exercise more, and may also be useful in the practice of medicine. This column will briefly explore what personal activity trackers are and what implications they may have for the practice of medicine. It will also discuss some of the problems inherent to these devices and ways that librarians can help users and health care professionals manage these devices. A brief list of currently available activity trackers is also included.

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What Are Personal Activity Trackers?

Like many other new technologies, there are no clear rules defining what makes a device an activity tracker. There are many devices on the market, and every manufacturer is trying to differentiate their product with unique features. For purposes of clarity, this column defines a personal activity tracker as an electronic device with the following features:

- is designed to be worn on the user's body;
- uses accelerometers, altimeters, or other sensors to track the wearer's movements and/or biometric data; and
- uploads activity data to an online application that shows trends over time.

There are many currently available devices that fit these requirements, from simple step trackers to smart fitness watches that monitor the wearer's heart beat and track their movements via GPS. Fitness trackers come in all shapes and sizes from wristbands to pendants and from to watches to small clips that attach to the user's shoe. Data upload is usually handled by a docking station attached to an Internet-enabled computer or via Bluetooth to a smartphone. Users access their data via a website, which usually features tools for goal-setting, long-term tracking, and social media functions such as sharing statistics and encouraging or competing with other users.

Many existing diet and fitness apps allow users to integrate activity tracker data into their products. MyFitnessPal <http://www.myfitnesspal.com>, a popular online dieting community that helps users to keep a diary of their food intake and exercise, currently integrates with over a dozen different activity tracker brands. This integration allows users to automatically pull their activity data over into the food tracking application. If they eat a cheese-burger for lunch and run an extra mile to make up for it, the two applications will share their data to give the user a clearer picture of their caloric intake and output. Weight loss site LoseIt <http://www.loseit.com> also allows users to connect many activity trackers to their food diary.

The desire to attach personal numeric data to everyday activities such as eating and exercising has been dubbed the "quantified self" movement. Adherents to this philosophy believe that if they can measure an aspect of their life on a regular basis, they can find a way to improve it. As Wolf put it, "the allure of the quantified self is a guess that many of our problems come from simply lacking the instruments to understand who we are."[1] Others describe the movement as one that "encourages people to use computers, smartphones, various electronic gadgets, and even pen and paper to track and manage one's sleep patterns, work, exercise, diet, and mood."[2] Members of the "quantified self" movement are simply using activity trackers as another tool in their arsenal to attach hard data to as many of aspects of their lives as possible.

Implications for Medicine

Activity trackers have the potential to be useful in the practice of medicine. Physicians have been advising patients to be more physically active for decades. Encouraging patients to track their activity could provide the daily reminder and motivation needed to make an exercise intervention truly successful. Majmudar et al. feel these devices could "close the feed-back loop between a patient's choices, actions, and overall health."[3]

Although the potential for trackers to be a motivating force is there, so far there is little evidence; a small trial conducted by Wang et al. found that "simply providing a wearable sensor/device for self-monitoring of PA [physical activity] was insufficient in achieving increases in target PA levels."[4] It will likely take years of experimentation to find the right mixture of activity tracking, positive feedback, and traditional counseling to maximize the positive effects of activity tracking.

In addition to being a motivator for exercise, physicians could ask patients to wear an activity tracker as a diagnostic tool. As Lyons et al. noted, "consistent, objective measures provided by these monitors could allow clinicians to identify at-risk individuals for secondary prevention and rehabilitation interventions."[5] At present, there do not appear to be any studies of activity trackers used in this way.

Another key application for activity trackers in medicine is as a low-cost and widely available method of sleep monitoring. Sleep studies conducted in a traditional setting are expensive and disruptive to the patient's daily life. Activity monitors can sense when a patient is moving and use that data as proxy for whether they are asleep or awake. Marino et al. found that wrist worn activity trackers were 86% accurate at measuring patients sleep or wakefulness; they consider "wrist actigraphy [a wrist worn activity monitor] a reasonable technique for measuring sleep."[6] The long-term tracking abilities of these devices "make them an attractive alternative to standard actigraphy in monitoring daily sleep–wake rhythms over several days."[7] Multiday stays in a traditional sleep laboratory are expensive and disruptive to the patient's daily life. If an activity tracker can approximate the results of a sleep lab, there is potential for huge savings.

Although there is definitely potential for activity trackers to positively impact sleep medicine, they are not a silver bullet. Van den Bulck urged caution against an overreliance on data from these devices, noting that there are likely to be many false positives and self-diagnosing patients.[8]

Activity tracking and data use in medicine is still in its infancy. Chung et al. found that only around one-third of activity tracker users currently share that data with their health care providers, and that "providers rarely engage with this data, which frustrates many of those self-trackers."[9] There are several reasons for this lack of provider engagement: sheer volume of

data, lack of time both in the appointment and outside it to analyze activity data, and lack of a useable export mechanism from most tracking websites. Until these issues are resolved, it is unlikely activity trackers will be broadly used in general practice.

Potential Problems

Although activity trackers show promise in motivating users and empowering them to participate in their health care, these devices are not without issues. Lee and Finkelstein noted one of the largest causes for concern: with the exception of one device (BodyMedia FIT), activity trackers are not regulated by the Food and Drug Administration as medical devices, and their manufacturers can make claims of "questionable or unverified qualities or benefits."[10] Device manufacturers are also not required to provide data about the accuracy and reliability of the data produced by these devices. Consumers assume the devices are 100% accurate, even though they can drastically over- or underestimate energy expenditure, especially for activities other than walking. Stackpool et al. found that "errors in measuring EE[energy expenditure] were, in general, unacceptably large and became larger with non-standard ambulation."[11] Users hoping for an easy way to track calories burned are likely to be disappointed with their results, especially if they engage in complex activities with many different movements.

There are also ethical and privacy issues surrounding activity data. Users may not be aware of all the data their device is gathering. In the case of GPS-enabled devices, activity logs will provide a daily log of the user's movements. If these data are stored on a website, as most are, there are very real risks for the user if that website is compromised. Users could find their devices implicating them in crimes or placing them at risk if malicious parties know their daily habits via tracking data. These ideas may sound far-fetched, but so did cars that report on driver behavior in accidents, and that technology is now widely used.[12]

Another problem with these devices is their potential to be used as a way to force people to be active. Employers and insurance companies have a vested interest in seeing employees become more active and healthier, thus lowering health care costs. Many companies have started employee wellness programs and are incentivizing activity tracking.[13] While improving employee health is a noble if not entirely altruistic goal, it is not a great leap from incentivizing positive behaviors to punishing unwanted behaviors. The ethical implications of forcing someone to wear a device that reports on their activities are troubling. However, there are ways around any system, as a group of British school children discovered while participating in an exercise study. Several participants attached their tracking devices to their pet's collars and racked up impressive step totals without getting off the couch.[14]

How Librarians Can Help

There are several ways librarians can help physicians and patients realize the benefits of fitness trackers and the "quantified self" movement. The first is to simply be familiar with these devices; know what they are capable of, what types of data they can capture, and where they store that data. Librarians should also be able to temper expectations and explain the limitations inherent in these devices. Physicians and patients may be convinced that an activity tracker will work as advertised, but as O'Brien et al. noted, "manufacturers of activity trackers provide little information about their reliability and validity."[15] Librarians can also act as a voice of caution for protecting the privacy of users who decide to share their activity data with their health care providers.

Another way for librarians to help is to assist with data export, management, and visualization. This can be a problematic area for many users because most devices do not offer a simple export tool and only allow social media sharing or API access to data.[9] Trackers with a sufficiently active user community will often have well-developed third-party tools for exporting data, but most users are not sophisticated enough to make use of those files. Librarians should be prepared to teach users to access activity data and format it in a way that can be shared meaningfully with their health care provider.

Lastly, librarians can advocate for transparency and standardization in how personal activity data is gathered, managed, and used. As professionals who have traditionally provided access to information while maintaining user privacy, librarians are uniquely equipped to help health care professionals manage the coming barrage of patient activity data.

Currently Available Trackers

At the time of this writing, these were some of the most popular personal activity trackers:

- FitBit <http://www.fitbit.com>: Multiple trackers available with a variety of features, from simple step counting to continuous heart rate monitoring. High-end models integrate with user's smartphone.
- Nike Fuelband <http://www.nike.com/us/en_us/c/nikeplus/nikefuel>: Wristband tracker pairs with smartphone. App has gamification features to encourage competition among users.
- Garmin Vivo <http://sites.garmin.com/en-US/vivo/>: Multiple trackers, some with sports-specific apps and phone integration.
- Jawbone <http://www.jawbone.com>: Multiple trackers that can track activity, sleep, and heart rate. High-end models include touchless payment system to replace credit cards.

- Xiamo Mi Band <http://www.mi.com/sg/miband>: Low-cost tracker that has many features including phone integration and sleep tracking.

Conclusion

Personal activity trackers are already being used by millions of people. There is a growing movement toward quantifying and storing data about everyday personal activities such as exercise and diet, and these trackers play a key role in gathering that data quickly and easily. At present there are no clear standards for accuracy and reliability of the data being gathered or how personal activity data are shared or managed. Librarians should be familiar with activity trackers so they can help physicians and patients manage activity data while protecting the patient's privacy.

Notes on Contributor

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