Chapter 81

Analysis and Linkage of Data from Patient–Controlled Self–Monitoring Devices and Personal Health Records

Chris Paton
University of Oxford, UK

ABSTRACT

This chapter outlines the recent advances in self-tracking technology both for wellness and healthcare purposes. It addresses one of the key challenges in mobile health: how to link the data from self-tracking devices with data in clinical data systems, such as Personal Health Records and Electronic Health Records systems. This chapter also discusses advances in visualisation and analysis for personally controlled data from self-tracking and PHR systems.

INTRODUCTION

In recent years, a large number of personal self-tracking devices have emerged onto the consumer marketplace (Swan, 2009). Self-tracking devices cover a wide range but include devices that measure activity using accelerometers to disposable stick-on patches that measure ECG readings. The vast majority of these devices are used for the purposes of monitoring exercise for fitness and weight-loss, but a significant minority is used for monitoring a range of health conditions including diabetes (Gross, Levin, Mulvihill, Richardson, & Davidson, 1984), COPD (Koff, Jones, Cashman, Voelkel, & Vandivier, 2009), heart failure (Klersy, De Silvestri, Gabutti, Regoli, & Auricchio, 2009) and Parkinson's disease (Little, McSharry, Hunter, Spielman, & Ramig, 2009), to choose a few examples.

In this chapter, we discuss the current landscape of self-tracking devices and examine how the data collected from such devices could be integrated into the clinical health record of the patient or consumer thereby making the data more useful for management of chronic conditions and maintaining good health.

Self-Tracking for Wellness

By far the most prevalent group of self-trackers are the fitness fanatics, dieters and "worried well". Arguably, this is also the group where self-tracking can have the largest impact on the health of the individuals and the state of the healthcare system. The personal health benefits of keeping fit and active have long been established (Franco et al., 2005). These include a lower risk of cardiovascular disease (Thompson et al., 2003), cancer (Thune & Furberg, 2001) and diabetes (Manson et al., 1991). From wider societal point of view, by remaining fitter for longer healthy individuals present a lower burden on healthcare services, take less sick-days (Proper, Van den Heuvel, De Vroome, Hildebrandt, & Van der Beek, 2006) and are able to take up caring and support roles longer into their retirement than individuals who take less exercise.

Evidence is emerging that self-tracking offers an increased incentive to keep fit and healthy over not self-tracking by increasing motivation through a process of feedback and a range of gaming effects (Swan, 2009). It will always be difficult to determine a clear link between increased take up of self-tracking technology for health and fitness and the general trend to increased exercise and health-consciousness among affluent consumers. However, recent behaviour change models may be able to demonstrate why this type of technology is enabling people to lead healthier lives. The Fogg behaviour model (Fogg, 2009) outlines a combination of three factors that influence whether or not an individual is likely to change behaviour: motivation, ability and triggers.

Self-tracking equipment has effects in all three of these domains:

Motivation

Many self-tracking tools have a "gamification" (McCallum, 2012) element built into them that can motivate users to compete both with themselves and other users through social networking platforms. For example, the Nike+ Fuelband® will display "points" on the LCD display mounted on the wristband that users can earn through increasing activity levels.

GPS tracker users can upload their GPS data from recent runs and share them with the community of users at Runkeeper.com. This could prove to be a powerful source of motivation as they become part of a community that congratulates and challenges each other to run further and faster.

Ability

Adopting a healthy lifestyle is a difficult challenge for most people. Certain types of self-tracking technology can make this transition easier by offering simple tools that replace the more difficult to maintain paper based systems of recording weights or activity levels. As discussed later in this chapter, the integration of data from self-tracking devices with clinical IT systems may be able to make the transition easier through advice from healthcare professionals on easier and more effective ways to maintain health and fitness that may not have been previously identified by patients.

Triggers

The Fogg model identifies triggers as a key to behaviour change (Fogg, 2009). Even if an individual has a high level of motivation and user-friendly tools that make the behaviour change easy to do, they still require a well-timed trigger to initiative the change. By using reminders and alerts, an ecosystem of technology that uses self-tracking devices, smartphone applications and web-based portals, individuals will be able to create triggers for exercise and activity that fit in with their daily regimens.

Self-Tracking for Long Term Conditions

Many of the positive behaviour changes established for currently healthy self-trackers also apply for patients with long-term conditions. There is increasing evidence that adoption of a healthy diet

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