



Personal technology for health: **curiosity or clinically useful?**

There are approximately 165,000 health “apps” currently on the market for mobile phone users. A health app is an application that runs on a smart phone to provide information, advice and feedback on health, fitness or wellbeing. While this could provide useful motivation for lifestyle change for some, a major drawback of most health apps is that the content and design has no input from medical professionals, and therefore could result in detrimental health effects for some users, depending on how much they rely on the app. If a patient asks for advice about using a health app, or is already using an app, there are some key points that clinicians can work through with the patient to ensure that they are making the best decisions for their health and wellbeing.

Personal technologies for health include mobile phone apps, pedometers and activity and fitness trackers (e.g. watches). Many of these technologies are focused on healthy lifestyle and fitness, but there are also apps which are designed to help patients manage specific medical conditions, e.g. diabetes and asthma.

Health apps aimed at patients have generally been designed to fulfil one or more of the following functions:¹

- Increase accessibility to health information
- Track health information, e.g. diet and physical activity
- Link to social media, e.g. sharing and comparing running times
- Provide entertainment for health purposes, e.g. carbohydrate counting games for people with diabetes
- Perform calculations and analyses, e.g. calculating insulin doses or analysing an image of a skin lesion

The common thread of these technologies is that they provide users with health information and advice, monitoring of health goals and behaviour reinforcement. The questions that arise for clinicians are whether the information these technologies provide is reliable and whether using them improves patient outcomes or if they could actually cause harm.

Weighing up the potential benefits and harms of health apps

When designed to meet a clinical need and properly assessed in appropriate trials, health apps and devices have the potential to deliver benefits to patients and clinicians and alter the way healthcare is delivered. The problem is that not many apps have evidence of clinical robustness.

The design and introduction of health apps has primarily been driven by developers (sometimes pharmaceutical companies) who have seen a market opportunity, rather than by clinicians with a desire to improve patient health or the functioning of the health system.

Independent assessments of health apps have found that:^{2,3}

- The majority of apps have no evidence of involvement of health professionals, universities or patient organisations in their development
- The information content of most apps does not align well with current evidence
- Many apps offer the potential for harm by providing erroneous information or acting as unapproved medical devices

Research into the quality and content of health apps for people with specific medical conditions has almost universally concluded that most perform poorly across a range of assessments; examples include poor quality apps for asthma, diabetes self-management, estimation of cardiovascular risk and scoring of disease activity for patients with rheumatological conditions.^{2,3}

Even well made apps may have content or features which are not entirely suitable for users in New Zealand (or any other country outside of the target market), such as advice based on international guidelines which recommends medicines or treatments that are not available.

Various commentators have suggested that some form of app curation or approval by recognised clinical authorities is needed.^{2,3} However, at present a very limited range of such lists are available (see: "Where can I find good apps?", Page 6).

Potential benefits of health apps include:^{2,3}

- May provide understandable health information for patients with low health literacy
- May reduce barriers for patients in rural and remote areas
- May empower patients to take responsibility for their health care

- May be more cost-effective than face-to-face consultation
- May result in positive lifestyle changes, e.g. weight loss, increased fitness

Potential adverse effects and limitations of health apps include:^{2,3}

- May be misused or misunderstood by patients with limited technology skills or low health literacy
- May discourage patients from seeking face-to-face health assessment when necessary
- May result in a missed diagnosis through false reassurance or inaccurate measurements
- The single focus of apps may mean patients miss other health concerns
- May cause obsessive focus on health or fitness; which may also result in unnecessary use of health resources
- Financial cost to the patient
- Lack of research on efficacy and robustness of information
- Lack of regulation
- Issues around the confidentiality and privacy of the information provided to the app

Poorly designed apps have the potential to cause harm

Some apps may provide incorrect advice or measurements which are unreliable, resulting in a potential risk to a patient's health. For example, one of the top ten downloaded apps in 2014 claimed to be able to measure blood pressure via a phone's camera and microphone. There is no evidence of whether this is actually possible, or accurate, and a disclaimer appears in the fine print that the app is for entertainment purposes only.⁴

Similar disclaimers are found on popular apps for self-diagnosis. Patients who rely on a health app for self-diagnosis may be falsely reassured by an inaccurate assessment. For example, a melanoma detection app was found to have only 10% sensitivity to detect biopsy-proven melanomas.² Conversely, if a patient is "diagnosed" with a condition that they do not have through use of an app, this is likely to result in increased anxiety and distress, as well as the cost of any unnecessary consultation with a clinician.

A systematic review of 46 apps for calculating insulin dose found that 67% risked making an inappropriate dosing recommendation.² Similarly, a systematic review of apps for asthma management found that one-third contained incorrect information about using an inhaler.²

Health apps can reinforce illness behaviour

Too much involvement in health apps may result in some patients becoming obsessive about their health and unduly focused on detecting illness. Some patients with chronic health problems who use an app may not be able to “switch off” and are constantly reminded of their condition. In patients with type 2 diabetes, there is evidence that too many reminders in the form of self-monitoring of blood glucose levels can have adverse psychological effects, including feelings of guilt, futility and not being in control.⁵

Health apps may even directly cause harm. In 2014, the FDA advised against the use of apps and associated devices which allow expectant mothers to monitor fetal heartbeat using Doppler ultrasound, due to the unclear risks of excessive ultrasound exposure.⁶

How effective are weight loss and fitness apps and devices?

Among the hundreds of health conditions that are the focus of a health app, apps that target weight loss, improving dietary intake and increasing physical activity levels are some of the most popular. There have been few studies into the efficacy of apps designed for these purposes. Those that have been done have often included components such as text-message support and follow-up from a dietitian or counsellor. Systematic reviews of these studies suggest some people lose weight and improve lifestyle behaviours with the use of an app, but evidence is mixed.^{7,8} It is uncertain whether patients using an app alone would achieve the same results as seen in clinical trials.^{7,8}

Some apps may function as unapproved medical devices

Due to their functionality, some apps available to New Zealand consumers fall under the definition of a medical device, despite not having appropriate approval in New Zealand for this. Patients should be advised to use these apps with caution as the reliability and validity of their functions are unclear.

A medical device includes any device, instrument, apparatus, appliance, or other article that is intended to be used in, on, or for humans for a therapeutic purpose. Medical devices sold in New Zealand must be labelled with the manufacturer or the manufacturer’s distributor in New Zealand. Most apps are developed overseas and it is unlikely developers will seek specific regulatory approval for a small market like New Zealand. Apps produced in the United Kingdom or United States which function as medical devices should have approval from the

A randomised controlled trial in Auckland into the effect of apps for improving fitness in young, inactive people found no overall improvement in participants’ fitness after using an app.⁹ Some participants did not like the apps and hardly used them (reasons given included lack of time, lack of interest and finding the app tedious to operate), whereas others found them beneficial and reported that they would keep using them after the study and thought they would help them achieve fitness goals.⁹

Most weight loss and fitness apps incorporate a limited range of strategies for producing behavioural change, e.g. how to read nutrition labels, relapse prevention, developing a regular pattern of eating, time management and stress reduction.^{10,11} Therefore, patients may not learn the same skills and derive the same benefit as they would if they were able to see a dietitian or health professional trained in assisting patients with weight loss.

Pedometers (step counters) are one of the earliest forms of wearable health technology and have been the most thoroughly assessed. A meta-analysis of pedometer use for weight loss, that included nine clinical trials with a total of 307 overweight individuals, found that on average, use of a pedometer for 16 weeks resulted in a mean weight loss of 1.27 kg (95% CI: 0.70 – 1.85 kg).¹² The longer people used a pedometer, the greater the degree of their weight loss; the longest study of pedometer use lasted for one year and resulted in an average increase of 1,800 steps per day and 3.7 kg weight loss.¹²

Medicines and Healthcare Products Regulatory Agency (UK) or Food and Drug Administration (United States).

Examples of apps which could meet the definition of a medical device include those that:

- Use extra attachments to perform a function which would usually be done by a medical device, e.g. apps which use ECG leads to display a heart rhythm, or attach to a blood glucose sensor to guide insulin dosing
- Use built-in functions of the phone to perform tasks that could be done by a medical device, e.g. apps which analyse an image of a skin lesion or apps emitting sounds to provide hearing tests
- Work in with an existing medical device, e.g. apps used to calibrate or control a cochlear implant, control the inflation and deflation of a blood pressure cuff or connect to an insulin pump

Where can I find good apps?

There are a small number of online directories and studies which have independently assessed health apps. For example:

Weight loss and smoking cessation apps assessment, 2015

Medical students and researchers from the University of Otago, Wellington evaluated 60 weight loss and 60 smoking cessation apps. The apps, which were developed in various countries, were evaluated according to how well they aligned with smoking cessation and weight management advice from the Ministry of Health, their cultural appropriateness for Māori and other features such as engagement and usability. The highest rated weight loss and smoking cessation apps for Android and iOS (Apple) operating systems were:

	Smoking cessation	Weight loss*
iOS	Quit Now: My QuitBuddy (Australian National Preventive Health Agency)	Calorie Counter and Food Diary by MyNetDiary (MyNetDiary Inc.)
Android	My Quit Smoking Coach (Andreas Jopp)	Noom Coach: Weight Loss Plan (Noom Inc.)

* N.B. bar code scanners in these weight loss apps do not work in New Zealand

For further information, including other high scoring apps, see: www.otago.ac.nz/wellington/otago119763..pdf
www.vimeo.com/133304804



Apps for patients with diabetes

James Nuttall, a dietitian at the Auckland Diabetes Centre, has researched apps for patients with diabetes, including their relevance to patients in New Zealand. He discusses the pros and cons of five popular diabetes apps in an article in Diabetes New Zealand magazine.

N.B. apps involving insulin dosing calculators are often associated with errors and these measurements should be used with caution.²

See: www.diabetes.org.nz/__data/assets/pdf_file/0018/12708/diabetes_autumm_2015_which_diabetes_app.pdf

iMedicalApps

This is a United States-based site, where apps are independently reviewed by clinicians, medical trainees and technical advisors. The Cochrane Collaboration lists iMedicalApps as a trusted, evidence-based website.

See: www.imedicalapps.com

National Health Service (NHS), UK

The NHS website lists apps which may help patients with smoking cessation, improving and tracking dietary intake, increasing exercise and moderating their alcohol intake. It is unclear what criteria have been used as the basis for assessing these apps.

See: www.nhs.uk/conditions/nhs-health-check/pages/tools-and-technology-that-can-help.aspx

www.nhs.uk/Tools/Pages/Toolslibrary.aspx?Tag=Downloads+and+widgets

MyHealthApps

This is an online directory of apps, based on the European Directory of Health Apps, printed in 2012. Apps are nominated and reviewed by patient or consumer groups. Information about the developers, their funding, contact details and whether medical professionals were involved in the app's development must be in the public domain for the app to be listed.

See: www.myhealthapps.net

Although this amount of weight loss may seem small, in the United States Diabetes Prevention Program overweight participants had a 55% reduction in the risk of developing type 2 diabetes over three years with a weight loss of 5 kg (equivalent to 5.3% of their initial body weight).¹³

Fitness trackers and activity monitors typically include a pedometer with additional functions such as heart rate or sleep monitoring, and are usually worn on the wrist. There may also be a supporting website where users can view their information and receive motivational, dietary or exercise advice and share information on social networks. There is currently little evidence that activity trackers are more effective in achieving weight loss or increasing activity than a simple pedometer. For example, one study of overweight postmenopausal women (average age 60 years) found that a pedometer provided the same benefits (increased activity levels) as a more expensive activity tracker.¹⁴ Current research suggests that sleep tracking functions on activity monitors are not able to identify waking accurately and consequently overestimate the time spent asleep.¹⁵

Questions to discuss with patients considering using apps

1. **Who are the developers?** Has the app been developed by an independent company, e.g. a respected patient organisation or medical authority, or a company with an "ulterior motive", e.g. a pharmaceutical company who manufactures a medicine related to the topic of the app.
2. **Where did they get their information?** Check if the app lists where the information provided comes from, whether the source is appropriate, e.g. a clinical practice guideline, and whether it is regularly updated.
3. **Is the app content and advice suitable for New Zealand?** Information related to investigation and treatment of the health condition covered by the app may not be appropriate, or align well with New Zealand guidelines, if apps are designed for an overseas market.
4. **Is there a disclaimer?** e.g. "for entertainment purposes only".
5. **Does the app record patient data?** e. g. food intake, an exercise log, location data or health information. Is the patient comfortable with the level of privacy and security of their information? Is this information used to target advertisements to the user?
6. **Does the app take physiological measurements?** Ensure the patient knows that these measurements may not be accurate and should not be relied upon.

7. **How is the patient proposing to use the app?** Advise patients not to make any treatment decisions or alter the dosing or frequency of their medicines on the basis of apps.
8. **Is it all a bit too much?** Consider whether the app may be causing harm, such as obsessive fixation on body weight or food intake, or "disease mongering" behaviour.

References:

1. Klasnja P, Pratt W. Healthcare in the pocket: mapping the space of mobile-phone health interventions. *J Biomed Inform* 2012;45:184–98. doi:10.1016/j.jbi.2011.08.017
2. Wicks P, Chiauzzi E. 'Trust but verify' - five approaches to ensure safe medical apps. *BMC Med* 2015;13:205. doi:10.1186/s12916-015-0451-z
3. Armstrong S. Which app should I use? *BMJ* 2015;351:h4597. doi:10.1136/bmj.h4597
4. Husain I. Top 10 downloaded iPhone health app can cause significant patient harm. *iMedicalApps* 2014. Available from: <http://www.imedicalapps.com/2014/07/iphone-health-app-patient-harm/> (Accessed Nov, 2015).
5. Barnard KD, Young AJ, Waugh NR. Self monitoring of blood glucose - a survey of diabetes UK members with type 2 diabetes who use SMBG. *BMC Res Notes* 2010;3:318. doi:10.1186/1756-0500-3-318
6. Office of the Commissioner. Consumer updates - avoid fetal 'keepsake' images, heartbeat monitors. 2014. Available from: <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm095508.htm> (Accessed Nov, 2015).
7. Aguilar-Martínez A, Solé-Sedeño JM, Mancebo-Moreno G, et al. Use of mobile phones as a tool for weight loss: a systematic review. *J Telemed Telecare* 2014;20:339–49. doi:10.1177/1357633X14537777
8. Bacigalupo R, Cudd P, Littlewood C, et al. Interventions employing mobile technology for overweight and obesity: an early systematic review of randomized controlled trials. *Obes Rev* 2013;14:279–91. doi:10.1111/obr.12006
9. Direito A, Jiang Y, Whittaker R, et al. Apps for IMproving FITness and increasing physical activity among young people: the AIMFIT pragmatic randomized controlled trial. *J Med Internet Res* 2015;17:e210. doi:10.2196/jmir.4568
10. Pagoto S, Schneider K, Jovic M, et al. Evidence-based strategies in weight-loss mobile apps. *Am J Prev Med* 2013;45:576–82. doi:10.1016/j.amepre.2013.04.025
11. Direito A, Dale LP, Shields E, et al. Do physical activity and dietary smartphone applications incorporate evidence-based behaviour change techniques? *BMC Public Health* 2014;14:646. doi:10.1186/1471-2458-14-646
12. Richardson CR, Newton TL, Abraham JJ, et al. A meta-analysis of pedometer-based walking interventions and weight loss. *Ann Fam Med* 2008;6:69–77. doi:10.1370/afm.761
13. Hamman RF, Wing RR, Edelstein SL, et al. Effect of weight loss with lifestyle intervention on risk of diabetes. *Diabetes Care* 2006;29:2102–7. doi:10.2337/dc06-0560
14. Cadmus-Bertram LA, Marcus BH, Patterson RE, et al. Randomized trial of a Fitbit-based physical activity intervention for women. *Am J Prev Med* 2015;49:414–8. doi:10.1016/j.amepre.2015.01.020
15. Lee J, Finkelstein J. Consumer sleep tracking devices: a critical review. *Stud Health Technol Inform* 2015;210:458–60.