**Not all steps are equal: Changing algorithms in wearable trackers changes outcomes**

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This blog entry discusses JM, a female patient recovering from a heart attack. She is just one example of many patients I have encountered who monitor and track their activity using a wearable tracker. JM shared her experiences and her disappointment that her normal walk had less activity recorded from one day to the next. Her friends at cardiac rehabilitation all noticed the same thing and had the same concerns. Fortunately, I was able to let them know that Fitbit had changed its algorithm for tracking minutes of moderate to vigorous activity and that this was the reason for the lower recorded activity levels.

What does this mean? The algorithm for activity trackers has changed so that increments of moderate to vigorous activity are no longer recorded in single minutes, but in 10-minute bouts. Previously, Fitbit just counted very active minutes when calculating a user's overall minutes, but from now on it will only count active minutes if a wearer engages in an activity for over 10 minutes. So, in practical terms this doesn’t mean much to an athlete (who believes more in the ‘no pain no gain’ approach), but to someone starting a recovery activity program the sudden change could be the difference between achieving goals and giving up. A patient exercising for 39 minutes for example would now see their activity recorded as three 10-minute bouts, not as four 10-minute bouts. Thus, the 10-minute bout threshold would need to be met with each separate exercise or physical activity session. More importantly, the change to the algorithm is more likely to affect how the device tracks the length of time the wearer spends sitting down (sedentary time). Not standing is linked to many chronic health problems, as is sitting for up to 7 or 8 hours a day - which can increase the risk of death by 5%1, 2.

Wearable activity tracking devices have sparked interest worldwide and provide a novel approach to monitoring physical activity. Data generated by these devices can be used by consumers, researchers, clinicians, and insurers to improve health and wellness. They can also help people to have better discussions with their doctor about their health. These benefits are so valuable that the National Health Service NHS (<https://www.theguardian.com/society/2016/jun/17/nhs-to-offer-free-devices-and-apps-to-help-people-manage-illnesses>) in the United Kingdom has even announced that it will provide trackers and apps upon prescription to people with heart disease. Given their important role in managing health and wellbeing, it is not surprising that global wearable tracker sales have dramatically increased. A report showed ([http://www.thetimes.co.uk/article/unfit-for-purpose-exercise-trackers-40-off-the-mark-7jltssgxn?shareToken=7aba357d23d8f831e348429bd79 5a47b](http://www.thetimes.co.uk/article/unfit-for-purpose-exercise-trackers-40-off-the-mark-7jltssgxn?shareToken=7aba357d23d8f831e348429bd79%205a47b)) Fitbit, the most popular brand of tracker, has sold almost 21.5 million devices worldwide with the Apple Smartwatch hot on its heels with 12 million sales.

How precise do we need activity trackers to be? This is debatable. Manufacturers can change the algorithm they are using to calculate activity at any time, and from time to time, they have made such changes. But they don’t need to tell users – and that is the problem. This can have marked effects on activity outcomes and monitoring.

*Every minute matters*

Wearable activity trackers provide innovative ways to monitor your physical activity in real time, with little inconvenience. Importantly activity trackers may also be an activity motivator. Indeed, they have the potential to motivate wearers to achieve their activity goals through a combination of elements such as self-monitoring, continuous feedback on progress, the ability to set reasonable goals, access to social support, and enhanced self-confidence. But how important is the device’s tracking accuracy and encouragement for the wearer to achieve personal activity goals (e.g. number of step counts or active minutes)? This is the issue that needs to be debated.

A change in the algorithm will change the results. So, when Fitbit™ announced it was changing the algorithm used to track active minutes it was understandable that the wearer was left feeling very confused about what the new readings may mean. Fitbit™ explained that the new10-minute rule meant that from now on, the wearers’ active minutes may sometimes appear lower than what they were used to. Highly active people who do a lot of physical activity over the day may regard this as only a small change that requires a relatively simple adjustment in how they monitor their daily activity. For other less active wearers, changing the algorithm may motivate them to set small goals - that is to encourage them to complete the 10-minute bout of activity.

Yet, things are not so simple for researchers and for patients recovering from a disease, where every minute of activity matters for monitoring or motivational purposes. For instance, the severity of disease for patients with heart failure is different than for patients who have not experienced heart damage such as occurs with elective coronary interventions. This can affect the patient’s personal goals for achieving the recommended accumulation of active minutes. It appears the manufacturers are not fully clear about the different ways the devices are used, or can be used. Contributing to the confusion is the fact that the manufacturers are very secretive about the algorithms they use to calculate the active minutes.

*Can we trust our trackers?*

Before we can trust our trackers we need research that shows the algorithms are good for accurately calculating cumulative moderate/vigorous minutes of activity and steps over the day. This will help to sharpen the accuracy of the trackers, build credibility, and to make sure the tracker algorithm supports the health experts’ recommendations for physical activity.

*Studies lose precious time*

Research is being undertaken and the evidence is building on the accuracy of the algorithms being used in activity trackers. Some studies have even recommended the use of Fitbit devices in specific clinical settings to measure physical activity. For instance, Alharbi et al.3 revealed Fitbit-Flex is an accurate monitor to measure free living physical activity (i.e., step counts and minutes of moderate to vigorous physical activity) in phase III cardiac rehabilitation participants. This study clearly demonstrated Fitbit-Flex being within 20% of the acceptable validity criteria for clinical purposes to measure step counts and minutes of moderate to vigorous physical activity. However, Fitbit-Flex exceeded the acceptable validity criteria for research purposes which is within 3%3. Similarly, a study conducted in a laboratory setting showed Fitbit-One has high accuracy to measure step counts in healthy young adults, with percent relative error below 1.3% for all tested treadmill walking speeds and for multiple placements (e.g. on the hip or in the pocket)4. Therefore, when manufacturers make changes to the algorithm the evidence from these studies becomes outdated, and so reopens the question of their reliability.

*Where to from here?*

Change is constant in the world of health and fitness. One such change is that people are gaining more control over their lifestyles, health, and future well-being by using wearable activity monitoring devices. There is no doubt that these trackers help to achieve better health outcomes and disease reduction. But tracker manufacturers need to keep users and researchers up to date about any changes they make to the algorithms. Being informed fosters trust and strengthens connections between users and manufacturers. It also helps researchers, physicians, clinicians, healthcare systems and insurance providers to properly respond the changes and assist people to achieve their health goals.

*Take home messages*

* Clinicians, patients and researchers are eager to have accurate trackers to monitor and motivate physical activity. Therefore, tracker manufacturers should ensure that the device algorithm provides a high level of accuracy similar to those of known devices such as a research-grade accelerometer (the Acti-Graph)
* System developers and designers need to ensure open lines of communication with researchers and consumers when changing algorithms to gain their trust
* Researchers should be mindful of the possibility that tracker manufactures may change their algorithms in the middle of a longitudinal research study without any notification. Thus, supplementary evidence of field-based performance is crucial to ensure data safety

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