

Wearables for Home Post-Operative Monitoring: Proof of Concept



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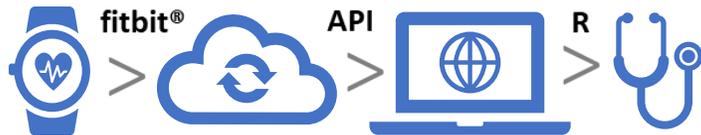
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Introduction

We hypothesise that wearables could transform perioperative care, including through facilitating early-discharge, a key tenant of Enhanced Recovery After Surgery (ERAS), by enabling remote patient monitoring of physiological & functional variables.

Methods

Utilising a commercially available fitness tracker (Charge 4, Fitbit®) and Application Program Interface (API) it was possible to import measured data into R for further statistical computation.



Both physiological (heart rate (HR)) and functional (sleep duration, step count) variables were accessible. Whilst the device includes a pulse oximeter, this is unavailable via the API at present.

Owing to COVID-19 this methodology was trialled on a single volunteer, over a 24-hour period, and serves only as a proof of concept.

References & Code

R code for data import & analysis freely available at: <https://ctomlinson.net/tag/EBPOM2020/>

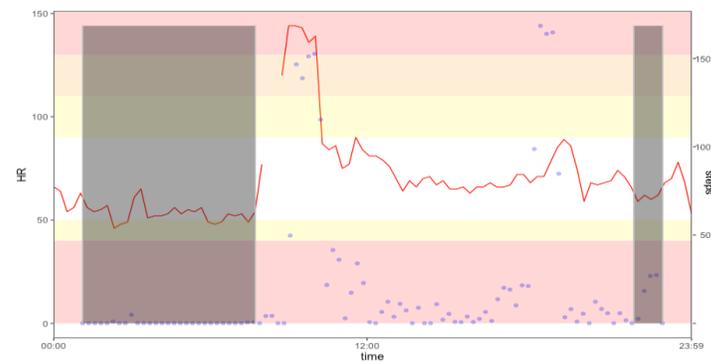
Royal College of Physicians. *National Early Warning Score (NEWS) 2: Standardising the assessment of acute-illness severity in the NHS*. Updated report of a working party. London: RCP, 2017.

P. S. Myles, M. P. W. Grocott, O. Boney, S. R. Moonesinghe, on behalf of the COMPAC-StEP Group. Standardizing end points in perioperative trials: towards a core and extended outcome set, *BJA: British Journal of Anaesthesia*, Volume 116, Issue 5, May 2016, Pages 586–589.

Results

Figure 1 displays Heart Rate (red), Steps (blue) 15-minutely and sleep (grey shading) over 24 hours. HR reference ranges from the National Early Warning Score 2 are represented by yellow, orange & red horizontal ribbons, corresponding to NEWS scores of 1, 2 & 3, respectively (RCP, 2017).

Figure 1: Heart Rate, Step Count & Time Slept



Once can easily 'eyeball' a resting HR of ~53, a peak of ~145 during exercise and that HR was generally within normal limits on the NEWS2 score. They undertook two periods of exercise, lasting ~90 & ~60 mins, respectively, and slept for ~7.5 hours, with little disturbance.

Discussion

From the recorded parameters we may expect to see patterns of abnormalities consistent with post-operative complications, for example pain illustrated by a tachycardia and reduction in activity and sleep (Table 1). This could be greatly enhanced with SpO2, via an API update.

Table 1: Hypothesised Parameter Abnormalities

	HR	Steps	Sleep	SpO2*
Pain	↑	↓	↓	-
Infection	↑	-/↓	-	-/↓
Pulmonary Complication	↑	-	-	↓
Reduced Movement	-	↓	-	-

*Not available via API at present

Other methods of outlier detection could include reference ranges (e.g. NEWS2 – visualised in Figure 1) or comparison with peers (e.g. 95th centiles). Following identification this may prompt increased follow-up, e.g. telephone call or 'push-notification' to patient outcome reporting app.

Furthermore, captured data contributes to a core & extended perioperative outcome set (Myles et al., 2016) for further high-quality research.

Conclusions

Remote patient monitoring, via wearable fitness trackers, is achievable and has potential to provide meaningful benefit, by facilitating early discharge and detection of complications, as part of an ERAS pathway. Following proof of concept we hope to trial this tool clinically.