LOCALIZING CHEMICAL AND BIOLOGICAL THREAT DETECTION

Using Wearables-based Health Data For AI-powered Diagnostics

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Background. The COVID-19 pandemic highlighted the value of continuously monitoring health and is partially responsible for the increased prevalence of wearable sensors that provide health information to users. Several signals that can be measured using wearables such as increases in resting heart rate and body temperature are well-established indicators of illness. These illness signatures are small in comparison to other physiological differences both within (e.g., due to physical activity or the time of the day) and between individuals. Wearables-based health measures are also noisy due to movement artifact, and the extracted metrics differ in frequency and accuracy between devices and vendors. Before being useful for AI-powered diagnostics, data from wearables needs to be better characterized. Purpose & Objective. The Rapid Assessment of Threat Exposure (RATE) dataset contains data from Oura rings and Garmin smartwatches, as well as labeled examples of COVID-19, other viral, and other bacterial illnesses. We will use the RATE dataset to understand the limitations of wearables data and develop threat-agnostic algorithms to detect changes in health from biological exposures before symptom onset. Rationale. Early exposure detection is critical for (1) prompt medical treatment and (2) preventing further spread by isolating exposed individuals. Methods. We analyzed the summary information provided by the wearables to determine which health metrics showed changes during illness, especially in the pre/early symptomatic window. We used the less processed, higher resolution data available from the sensors to develop new features using traceable methods. Preliminary Results. Twenty-eight individuals with non-COVID illnesses (e.g., influenza, strep throat, and other viral and bacterial infections) had Oura ring summary data corresponding to the time when they were sick. Oura's Body Temperature Score showed the most consistent differences between sick and healthy periods. The continuously measured skin temperature (Tskin) data (fs = 60s) varied significantly over the course of the day (<20-40oC). Focusing on times when the individual was sleeping and limiting the Tskin range to 32-38oC, we found that the nightly, within-person high temperature (90th percentile) was higher between sick and healthy periods, and that sleep periods where at least 50% of the data were above 36oC occurred more frequently. Heart rate variability (HRV) differences showed less discrimination between healthy and sick periods. While there were an increased number of low Oura HRV Scores, the reported HRV was noisy, even when limiting to sleep periods and a valid range of 10-120ms. Preliminary Conclusions & Impact. The Tskin measured by the Oura ring is sensitive to environmental conditions and the reported HRV is sensitive to movement artifact. Focusing on time periods when individuals were sleeping provided more stable data. Of the metrics examined, Tskin showed the most consistent differences during sick periods, and in particular the nightly high temperatures were greater. Combining nightly Tskin data with other continuous measures of health provides value for discriminating between illness and other physiologically stressful conditions. Next steps involve repeating this analysis for the individuals with COVID and assessing other measures of HR and HRV.

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