A 35-year-old CEO who detected COVID-19 with his wearable biosensor - a Case Report

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Abstract

The COVID-19 pandemic has led more people to start using wearable technology to track vital signs, physical activity, and sleep. The significant features of these devices include their capability to collect continuous, noninvasive data. We developed a COVID-19 risk stratification model using the Biostrap wearable device which utilizes a baseline-adjusted continuous scale and other escalation points-based on our recent case report, to enhance the National Early Warning Score (NEWS2). Preliminary research has found that our adjusted Early Warning Score (Biostrap-EWS) might be highly specific in identifying early-stage respiratory infections. We present the case of Biostrap CEO Sameer Sontakey, a 35-year-old man, whom the app notified as having a high likelihood of respiratory illness after which the diagnosis SARS-CoV-2 was confirmed with a nasal swab. Our Biostrap-EWS algorithm appears to detect respiratory infections in a real-world environment via passively collected biometric data. To validate the reliability of the algorithm, further research is required.

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Introduction

Adoption of wearable technology has accelerated during the COVID-19 pandemic, being widely used for monitoring of various health and wellness metrics such as vital signs, physical activity, and sleep (1,2). These devices provide high potential for identifying, tracking, and controlling the spread of infectious diseases like COVID-19 because of their ability to collect continuous, noninvasive data and monitor change in biometric trends over a period. (3) We have recently published a case report of two patients with confirmed severe-respiratory-syndrome-coronavirus-2 (SARS-CoV-2), showing significant changes in biometrics obtained with the Biostrap wrist-worn photoplethysmography device (Biostrap USA LLC, Duarte, CA, USA).

We developed a risk stratification system to detect respiratory diseases using a patient's daily and historical biometrics, also named Biostrap-EWS™, based on the National Early Warning Early Score (NEWS2) that is currently recommended in the United Kingdom for risk stratification of COVID-19 patients (4). Our Biostrap-EWS™ avoids the limitations of universal binning using a continuous scale relative to the patient's baseline (Figure 1) and respiratory-disease-specific escalation based on recently published literature (5,6). Our algorithm was found to be highly specific in preliminary analyses to identify early-stage respiratory diseases.

This case study shows how the Biostrap-EWS™ algorithm identified COVID-19 in Biostrap's Chief Executive Officer (CEO), Sameer Sontakey.

Case Presentation

Sameer Sontakey, CEO of Biostrap, is a 35-year-old male who adheres to a healthy lifestyle and has no comorbidities. He is also an avid user of his technology and used a beta version of the Biostrap app where the Biostrap-EWS™ algorithm was activated.

On the morning of January 13, the Biostrap detected an elevated respiratory rate and steady decrease in nocturnal oxygen saturation (Figure 2). That following day, he developed slight symptoms including a low-grade fever and headache, after which the Biostrap-EWS™ algorithm classified him as red, indicating a high likelihood of respiratory illness (Table 1). This notification prompted Sameer to schedule a nasal swab test on January 15, which confirmed a positive diagnosis of SARS-CoV-2.

Prior to the confirmed diagnosis, significant changes in nocturnal heart rate and nocturnal heart rate variability RMSSD were also recognized. Additionally, a peak in arterial elasticity on the second symptomatic day with a prolonged plateau phase lends evidence to the endothelial involvement of COVID-19 (7). Symptoms persisted until January 26, at which time all biometrics had returned to normal baseline values except for nocturnal respiratory rate.

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Discussion

Most patients with COVID-19 present with mild symptoms but with significant changes in biometric measurements that can be monitored with wearable technologies. Several models have been presented to detect acute illness, from simple respiratory rate measures(5) to the more advanced NEWS2, which has been primarily limited to intermittent measurements in mostly hospitalized patients (4,8). Primary limitations of the NEWS2 to detect anomalies include the lack of baseline data and use of universal scoring bins that do not account well for extremely fit individuals or those with pre-existing conditions.

This data suggests that our Biostrap-EWS™ algorithm may detect respiratory infections at an early stage in a real-world environment through passively collected biometric data. One notable observation in Sameer as well as the patients in our other case study is significant variation in arterial elasticity, likely due to endotheliitis, suggesting its utility to improve the sensitivity and specificity of early detection. Additional research is required to validate the reliability of early detection of respiratory infections with the Biostrap-EWS™ algorithm.

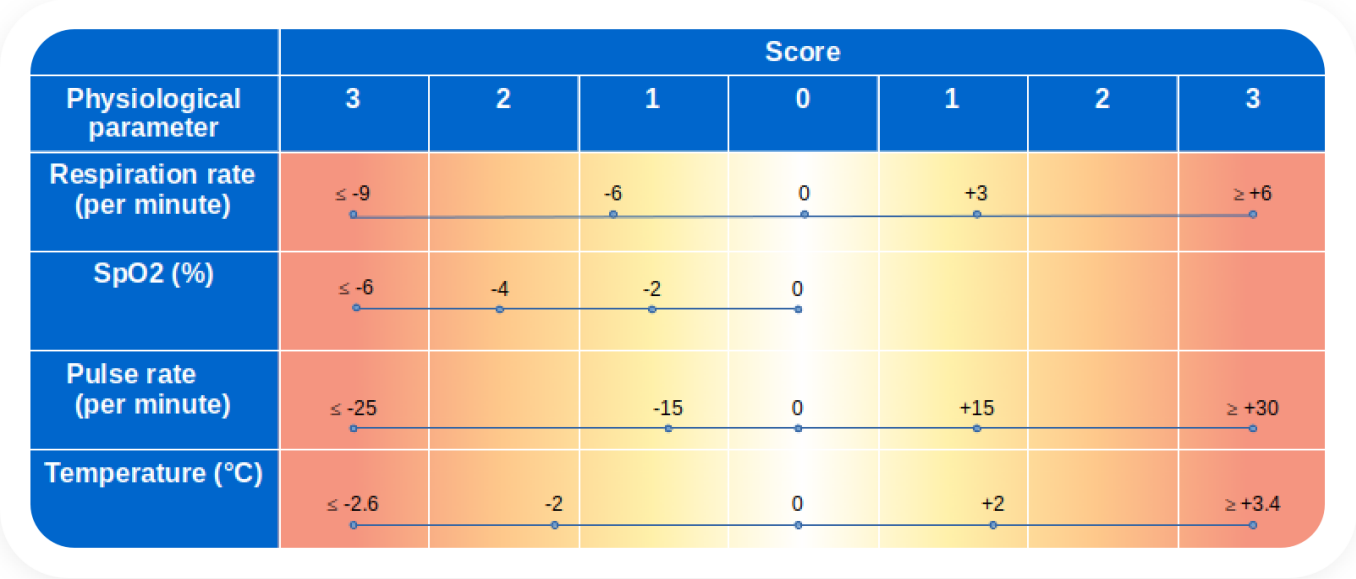

Figure 1. The Biostrap-EWS™ Algorithm

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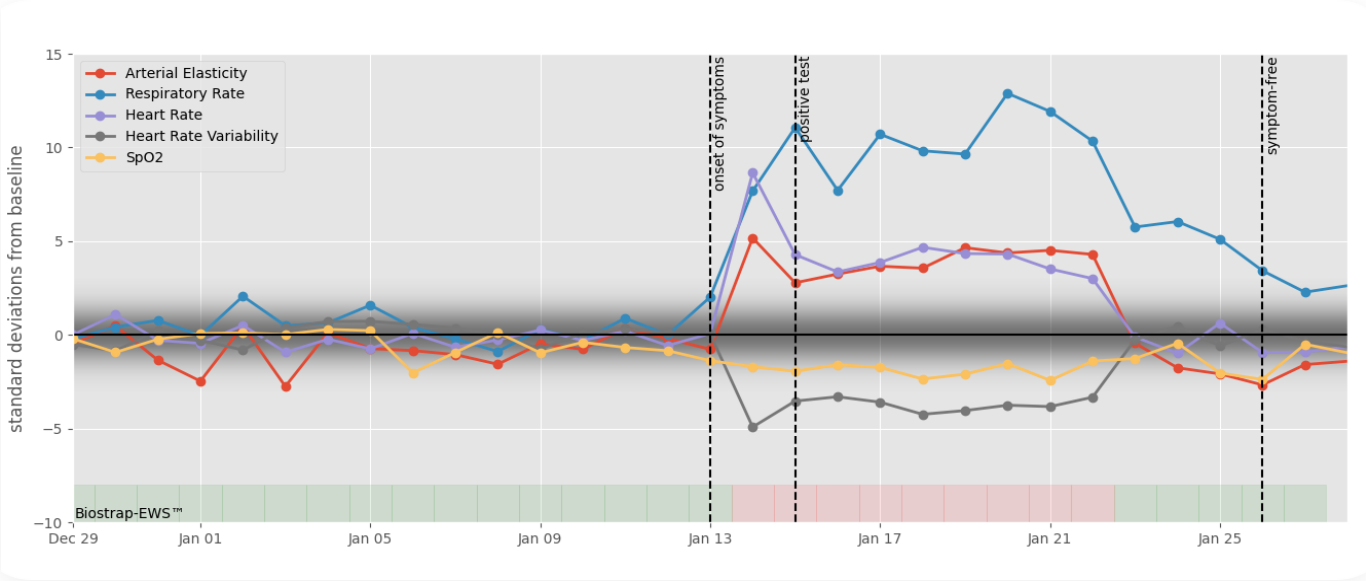

Figure 2. Biometric data collected by the Biostrap wrist-worn device and Biostrap-EWS™ algorithm. Daily averages for each of six biometrics are shown as the deviation from baseline (i.e., normalized by median and standard-deviation-consistent median absolute deviation.) The shading indicates where the deviations are expected for this person. Each colored line represents a single biometric trend from two-weeks prior to symptom onset throughout resolution of symptoms.
The colored bar at the bottom shows the actual indication of the Biostrap-EWS™ algorithm, where green represents low likelihood of respiratory disease, and red indicates a high likelihood of respiratory disease.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	12-Jan	13-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	20-Jan	21-Jan	22-Jan	23-Jan	24-Jan	25-Jan	26-Jan
No Symptoms															
Fever															
Headache															
Loss of Appetite															
Body Aches															
Loss of Taste/Smell															
Hyper Skin Sensitivity															
Cough															
Stomach Ache															
Brain Fog															
BAC-EWS Classification															

Table 1. Symptoms during Covid-19 with the detection of probability by the Biostrap app.

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