

# TECHNOLOGY INSIGHTS: Leveraging Sensors to Monitor COVID-19 Symptoms Remotely

MAY 2020



# Introduction

B.Next is the biodefense initiative from In-Q-Tel (IQT) focused on preparing for and mitigating biological threats that could affect national security. IQT is the long-standing partner to U.S. Intelligence community and its allies with a successful, 20+ year track record of investing, advancing, and transitioning critically needed technologies to support national security.

B.Next's experts from healthcare, government, and industry leveraged its knowledge and expansive network to create the following high-level guide that **maps sensors in commercial products to key vital signs and explores ways to capitalize on the smart products that may supplement digital health efforts in response to COVID-19.**

## What's Inside



Connection between health sensing techniques and relevant vital signs



Catalog of current product capabilities and emerging trends for future products



Highlight of some challenges with existing commercial solutions



Use cases for understanding potential ways to use sensors during contingency care



LEARN MORE: [bnext.org](https://bnext.org) & [iqt.org](https://iqt.org)



CONTACT: [info@iqt.org](mailto:info@iqt.org)

# Leveraging Remote Sensors for COVID-19 Response

## WHY SENSORS



Patients, at the direction of their clinical providers, might be asked to monitor for symptoms of COVID-19.

Using sensors that are already available in many **commercial products**, such as **smart watches**, can have **added benefits for responding to COVID-19**, including:

- ✓ Helping to reduce risk of unnecessary doctor office/emergency department visits
- ✓ Helping to ensure timely and expedited medical intervention when indicated

## USE CASES

Sensors that track everything from heart rate to temperature to pulse oxygenation can be utilized for remote monitoring and may prove especially powerful in managing patients in the following situations:



### Potential Exposure Tracking

*Ex: observing high-risk and healthy populations for early intervention*



### Alternate Care Site

*Ex: facilitating remote patient evaluation for less sick patients*



### Home Care Monitoring

*Ex: monitoring emergency room patient discharges for concerning changes*

## STANDARDS OF CARE DURING A PANDEMIC

Medical standards of care during a disaster fall on a spectrum ranging from conventional to contingency to crisis. As the world navigates the COVID-19 pandemic, **hospitals are operating increasingly under a contingency standard of care.**



Conventional

Contingency

Crisis

## CONTINGENCY CARE

- ❖ Deliver functionally equivalent **care** utilizing available resources
- ❖ Ex: use COTS smartwatch for monitoring in place of medical grade sensor device



# Identifying Health Sensing Techniques

Employing sensors that support COVID-19 patient care requires mapping relevant vital signs to commonly available sensor technologies.



## Blood Oxygen

Reduced blood oxygen saturation may signal respiratory infection. Sometimes it manifests as “silent hypoxia” with few symptoms. Sensors in pulse oximeters may detect the need for immediate attention prior to complaint of shortness of breath.



## Respiration Rate

Taking more than 20 breaths per minute at rest may signal underlying illness or fever. The capability is less common in fitness trackers, yet there are many commercial chest straps that measure respiration rate.



## Temperature

Elevated temperature is a consistent finding and should alert the individual to possible infection. Innovations include patches for continuous measuring and smart thermometers that may utilize user data to predict illnesses.



## Heart rate

Rapid heart rate is often a sign of infection and may be associated with an elevated temperature. It may also be due to diminished fluid intake or anxiety. Most fitness trackers and smart watches offer this capability.

### THRESHOLDS FOR NORMAL



Oxygen Sat > 92%



RR < 20



Temp < 100.4F



HR < 100

# Considering the Capabilities

Wearables have potential as worthwhile tools for COVID-19 care efforts, but it's important to understand the different capabilities existing in these off-the-shelf products.



## Sizing Matters

Wearables come in a range of sizes. Proper fit is critical to ensure consistent readings.



## Periodic HR Readings

Wearables either take periodic or continuous heart rate readings. Devices offering continuous readings are preferable.



## Trends vs Actual Values

For values like SpO2 (pulse ox), trend data may only be available instead of actual values, potentially impeding the benefits of real-time monitoring.



## Historical Data

Being able to store and review past data makes it easier to spot changes in health and identify opportunities for intervention sooner.



## Dedicated Device

Sensing techniques may adapt over time for the wearer, making it important to understand whether a device has a dedicated wearer or is shared among users.









































## Accuracy

The absolute value of readings may not be accurate and can vary between devices. But, readings on the same device will likely remain consistent and can detect changes in health.

# Selecting Common Products

Pew Research found 1 in 5 Americans owns a fitness tracker or smartwatch. These devices may be leveraged for remote patient monitoring. Below is a sample of makers and the vital signs their products can track.\*

	GARMIN	WITHINGS	FITBIT	APPLE	POLAR	SAMSUNG
Heart rate 						
Heart rate Variability 						
Pulse Ox (SpO2) 						
Respiration Rate 						
EKG 						
KEY: Feature available on:  Most or all products  Some products  Not available						

\*Based on products available as of 1 MAY 2020

# Understanding Challenges with Existing Solutions

Using existing sensors can provide early access to needed information, but it is important to understand limitations.



## CHALLENGES

Data quality varies from product-to-product or even between uses. Most are not intended to be “medical grade” (what would be found in a hospital or doctor’s office).



Many products don’t connect seamlessly with other devices or are “locked” to certain vendors. Data needs to be shared, standardized, and analyzed to amplify impact.



Using commercial products for contingency care will likely **expose personal information** and require exceptions in systems governing access, use, and protection of data.

## ADDRESSING CHALLENGES

- Collaborate with laboratories and universities to categorize devices and identify workflows that can produce reliable results. Solutions should have clearly defined risks for use.
- Convene developers and policy experts to identify standard data formats and encourage providers to employ best practices for exporting data from devices.
- Consult cybersecurity and privacy experts to identify best practices, encourage data encryption, ensure users understand the risks; allow users to “opt-in” for trials of at-risk sensors.

# Looking Ahead

Digital health solutions are critical to delivering comprehensive, flexible patient care. As the pandemic continues to evolve, so will sensor technologies and the data they capture. Below are some trends to watch.



**BACK-END ANALYTICS:** Less emphasis on physical design and more focus on strengthening back-end data, providing robust analytics and increasing data reliability.



**USER TAGGING:** More user-generated data, such as user tagging, which allows users to add data about how they feel or their environment, enriching population-based analyses.



**CONTEXTUALIZING TRENDS:** Shift from reporting data to analyzing metrics over time, helping to identify anomalies for early intervention.



**PARTNERSHIPS:** Increase in early, strategic relationships between companies, shaping key health metrics and subsequent report content.



## PIONEER PROFILES

*Whoop and Oura are two early innovators in this space.*

**WHOOOP STRAP:** Faceless smart band aimed at athletes, emphasizing analytics for physical recovery, strains, and more to enhance training outcomes.

**OURA RING:** Sleek finger band that measures sleep, heartrate variability and more, providing health scores and employing predictive analytics to customize recommendations.



# More about B.Next



## WHY B.NEXT

B.Next is uniquely poised to address urgent solutions required for the COVID-19 crisis and future pandemic events alike stemming from its collective expertise in real-world medical care, government service, academia, technology, and strategic investing.



## HOW WE WORK

- ✓ **Investments:** Explore and invest in diverse technology companies and offerings
- ✓ **Innovation:** Pursue projects in biotech and biomanufacturing, data analytics, digital health, and synthetic biology domains
- ✓ **Approaches:** Develop frameworks to understand industry gaps and opportunities
- ✓ **Strategic Advisors:** Provide expertise and capabilities to partners
- ✓ **Publishing:** Produce proofs-of-concept, thought pieces, blogs, and more
- ✓ **Dynamic Responses:** Pivot resources to support to real-time events



LEARN MORE [bnext.org](https://bnext.org) & [iqt.org](https://iqt.org)



CONTACT: [info@iqt.org](mailto:info@iqt.org)



## WHO WE ARE



### B.Next

**Tara O'Toole, MD** – Former Undersecretary of Science and Technology, DHS

**Luciana Borio, MD** – Former National Security Staff and former FDA Acting Chief Scientist

**Dan Hanfling, MD** – Former HHS/ASPR National Healthcare Preparedness Program

**Dylan George, PhD** – Former DoD, HHS/BARDA & OSTP

**Kevin O'Connell, PhD** – Former US Army Edgewood Chem/Bio Center; microbiologist

**Joseph Buccina** – Former JHU Center for Health Security ELBI Fellow; bioinformatics

**JJ Ben Joseph** – Former DoD, Computer Scientist, artificial intelligence developer

### In-Q-Tel

**Eugene Chiu** – Senior Partner, Investment Team; software and life sciences entrepreneur; McKinsey & Co.

**Grant Whiting** – Senior Associate, Investment Team; Bain & Co.; US Marine Corps.

# References

To learn more about the resources used to inform this document, please see below.

1. Pew Research, *About one-in-five Americans uses a smart watch or fitness tracker*, 9 JAN 2020 (<https://www.pewresearch.org/fact-tank/2020/01/09/about-one-in-five-americans-use-a-smart-watch-or-fitness-tracker/>)
2. Center for Disease Control and Prevention, *CARE: Check and Record Everyday*, Version 3:3.11.2020 ([https://www.cdc.gov/coronavirus/2019-ncov/downloads/COVID-19\\_CAREKit\\_ENG.pdf](https://www.cdc.gov/coronavirus/2019-ncov/downloads/COVID-19_CAREKit_ENG.pdf))
3. Institute of Medicine (IOM), *Guidance for establishing crisis standards of care for use in disaster situations: A letter report*. Washington, DC: The National Academies Press, 2009
4. Hick JL, Hanfling D, Burstein JL, et al., *Health care facility and community strategies for patient care surge capacity*. Annals of Emergency Medicine, Volume 44, Issue 3, 253 – 2612; 2004.
5. Institute of Medicine (US) Forum on Medical and Public Health Preparedness for Catastrophic Events, Medical Surge Capacity: Workshop Summary. Washington (DC): National Academies Press (US); 2010. E, Alternate Care Systems: Stratification of Care. (<https://www.ncbi.nlm.nih.gov/books/NBK32849/>)
6. Garmin International (<https://www.garmin.com/en-US/>)
7. Withings (<https://www.withings.com/us/en/>)
8. Fitbit (<https://www.fitbit.com/us/products>)
9. Apple (<https://www.apple.com/watch/>)
10. Polar (<https://www.polar.com/us-en/products>)
11. Samsung (<https://www.samsung.com/us/mobile/wearables/>)

# Disclaimer

This *Technology Insights Guide* provides an overview of the use of commercial-off-the-shelf (not medical grade) sensor technologies that might be useful in supporting the ongoing COVID-19 outbreak response.

The intent of this guide is to acquaint clinicians with the fundamental concepts related to the use of wearable sensors and to provide a possible adjunct to existing healthcare related strategies for managing the potential surge of patients with COVID-19 symptoms. Emphasis on technologies that could serve as an adjunct to conventional methods of patient monitoring are provided.

This effort is not intended to convey medical guidance or provide recommendations regarding the outpatient management of presumed or confirmed COVID-19 patients. It is intended as a supplement to support the ongoing efforts of the healthcare community currently managing COVID-19.