

1-2020

## Detecting Different States of Ventilation with a Wearable Device through Minute Ventilation

Yash Patel

Thomas Jefferson University, [yash.patel@jefferson.edu](mailto:yash.patel@jefferson.edu)

Michael Morano

Thomas Jefferson University, [michael.morano@jefferson.edu](mailto:michael.morano@jefferson.edu)

Marc J. Torjman, PhD

Thomas Jefferson University, [marc.torjman@jefferson.edu](mailto:marc.torjman@jefferson.edu)

InduPriya Eedara, MS

Moeness Amin, PhD

Follow this and additional works at: [https://jdc.jefferson.edu/si\\_ctr\\_2022\\_phase1](https://jdc.jefferson.edu/si_ctr_2022_phase1)  
See next page for additional authors

 Part of the [Translational Medical Research Commons](#)

[Let us know how access to this document benefits you](#)

---

### Recommended Citation

Patel, Yash; Morano, Michael; Torjman, PhD, Marc J.; Eedara, MS, InduPriya; Amin, PhD, Moeness; Loeum, Channy; and Joseph, DO, Jeffrey I., "Detecting Different States of Ventilation with a Wearable Device through Minute Ventilation" (2020). *Phase 1*. Paper 24.

[https://jdc.jefferson.edu/si\\_ctr\\_2022\\_phase1/24](https://jdc.jefferson.edu/si_ctr_2022_phase1/24)

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning \(CTL\)](#). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in Phase 1 by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: [JeffersonDigitalCommons@jefferson.edu](mailto:JeffersonDigitalCommons@jefferson.edu).

---

**Authors**

Yash Patel; Michael Morano; Marc J. Torjman, PhD; InduPriya Eedara, MS; Moeness Amin, PhD; Channy Loeum; and Jeffrey I. Joseph, DO

**Yash Patel**

**SI/CTR Abstract**

**Word count: 246 words**

**Detecting Different States of Ventilation with a Wearable Device through Minute Ventilation**

**Yash Patel, Michael Morano\*\*, Marc J Torjman, PhD, InduPriya Eedara, MS, Moeness Amin, PhD, Channy Loeum, and Jeffrey I Joseph, DO\***

(\*) indicates primary project advisor

(\*\*) indicates another student who is declaring the same project as primary for SI

**Introduction:** Detecting changes in respiration are essential to monitoring a patient's vital signs. Few devices accomplish this in a non-invasive manner. We are developing a wearable Trachea Sound Sensor that measures respiratory rate (RR), tidal volume (TV), minute ventilation ( $MV = RR \times TV$ ). A prototypical Trachea Sound Sensor (TSS) was created and compared to a reference pneumotachometer. Both were used to record the sounds of breathing with research team members.

**Methods:** The TSS recording device was tested on six research team members and breath sounds were recorded. Simultaneously, the member's RR and MV was recorded using a calibrated pneumotachometer. The researchers were instructed to adjust their breathing rate and depth while intervals were recorded. Signal processing techniques were used to analyze and produce measurements of RR, TV, and characterize hyperventilatory or hypoventilatory states.

**Results:** Based on the results, we found that it is possible to obtain accurate measures of RR and identify breathing patterns through the TSS. Signal processing and analysis calculated RR, states of hyperventilation and hypoventilation with 98% sensitivity and specificity. Results obtained for measuring TV were less accurate ( $\pm 100$  mL).

**Discussion:** Our results suggest that it is viable to obtain accurate measures of RR and classify breathing sounds solely on measurements of breathing sounds from the TSS. The inaccuracy in TV measurements may be partly due to the systematic error from the pneumotachometer used. The prototypical TSS are suitable for upcoming NIH-funded clinical trials to test the TSS in volunteers and hospitalized patients.