# Peripheral electrical stimulation for sedation-induced respiratory depression during procedural sedation and analgesia

## Overview

Sedation-induced respiratory depression is common during procedures performed with procedural sedation because the medications used are central nervous system depressants.

This project aims to develop a closed-loop system capable of delivering low-level peripheral electrical stimuli (PES) when respiratory depression is detected. The trigger for detecting respiratory depression will be derived from a transcutaneous carbon dioxide (TcCO2) monitoring system. Specifically, the PES will be triggered when the rise in TcCO2 over a specified interval has exceeded a set threshold.

Prior studies have confirmed the safety of applying peripheral electrical stimulation in a similar setting.1,2 Recently, a randomized controlled trial of PES was undertaken for 106 post-operative patients with obstructive sleep apnea. There were no adverse events related to the use of PES in this study.1 Results of the study also demonstrated initial evidence for the efficacy of this approach.1 Patients with obstructive sleep apnea who were randomized to receive PES had reduced duration and magnitude of hypoxemia during their stay in the post-anesthetic care unit.1

Although there are similarities between this previous study and our plans for the application of PES for respiratory depression during procedural sedation, there are some significant differences to consider. First, it will be essential to ensure that the application of PES does not ‘over-stimulate’ the patient and interfere with the efficacy of sedation. Second, it is common for patients receiving procedural sedation to receive supplemental oxygen routinely. Supplemental oxygen delays detection of respiratory depression by pulse oximetry. Ventilation can be assessed directly transcutaneous carbon dioxide monitoring systems.

## Methods

* TcCO2 as input (Sentec digital monitoring system with Vsign-2 sensor)
* Peripheral nerve simulator (DS7A, Digimeter - or similar) will be used to deliver electrical stimulation using a bar electrode to as closely replicate the system used by1 as possible.

The system is somewhat more straightforward than that used for the closed-loop system that used SpO2 as the trigger because the motion sensor, which is used to detect aberrant SpO2 measurements, is not required for monitoring TcCO2.

## References

1. Smith HM, Kilger J, Burkle CM, Schroeder DR, Gali B: Peripheral electrical stimulation reduces postoperative hypoxemia in patients at risk for obstructive sleep apnea: A randomized-controlled trial. Canadian Journal of Anesthesia/Journal canadien d’anesthésie 2019; 66:1296–309

2. Suen CM, Chung F: Pulse-ox paradox: Potential versus pitfalls of pulse oximetry monitoring in surgical patients with obstructive sleep apnea. Canadian Journal of Anesthesia/Journal canadien d’anesthésie 2019; 66:1286–90