# AUDIO PHONE OXIMETER

*Christian L Petersen, J Mark Ansermino, Guy Dumont*

The University of British Columbia, Vancouver, Canada

**Introduction:** Pulse oximetry is critically important in anesthesia as an early indicator of hypoxemia. Conventional pulse oximetry is widely used in the developed world, but many developing regions do not have access to this life saving technology due to lack of infrastructure (such as electricity) and the prohibitive cost of devices. The use of the ubiquitous cell phone as a vehicle for pulse oximetry may be a way to address these issues [1]. We describe a method for connecting an oximeter finger sensor directly to the generic audio port of a cell phone, thereby bringing cost to a minimum.

**Method:** We connected a standard NellcorTM oximeter finger sensor directly to the audio port of a second generation iPod TouchTM. The light emitting diodes in the sensor were lit by the headphone output signal and the photodiode signal detected directly by the microphone input. All signal processing, including signal quality estimation and heart rate and oxygen saturation extraction, was performed onboard the phone in a custom software application.

**Results:** The sensor was activated through the audio interface, and the sensor light appeared visually as bright as when operated by commercial oximeter hardware. The extracted red and infrared waveforms from the sensor were processed in real time using conventional algorithms adjusted for the AC coupled nature of the audio interface (see Fig 1). The application calculated heart rate and oxygen saturation (currently uncalibrated) in real time. Sufficient signal levels are obtainable with adequate sensor placement.

**Conclusion:** We have demonstrated the feasibility of a pulse oximeter consisting of a sensor cable connected to a cell phone through the audio interface. The manufacturing cost of such audio sensor cables is several orders of magnitude less than conventional hardware solutions, thus potentially allowing wider dissemination of pulse oximetry to remote regions of the world.

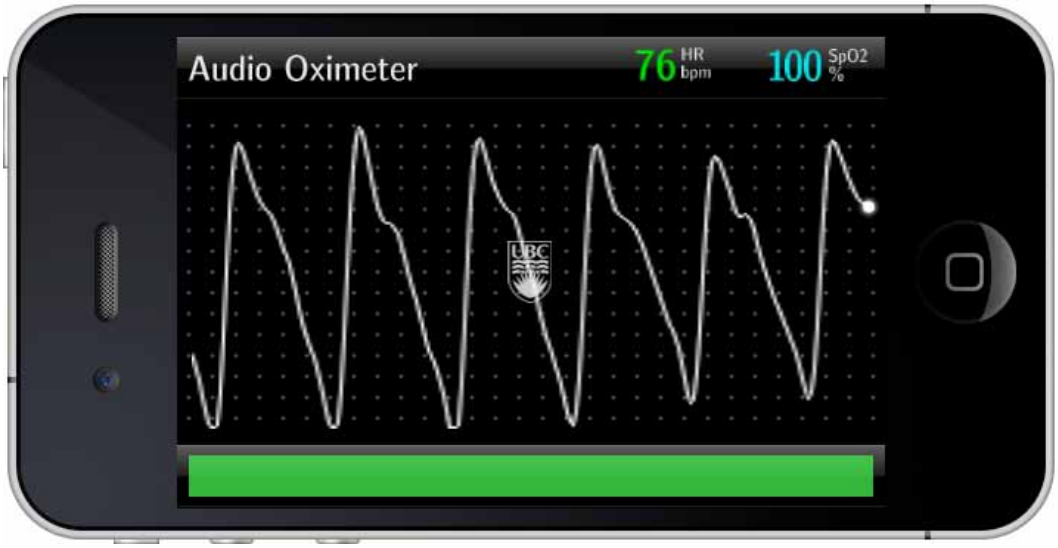


*Figure 1: Audio Oximeter showing plethysmogram, trends and signal quality (bottom bar).*

***References***

1. "Human-centered Phone Oximeter Interface Design for the Operating Room", W Karlen, G Dumont, C Petersen, J Gow, J Lim, J Sleiman, J M Ansermino, HEALTHINF 2011 Proceedings of the International Conference on Health Informatics (2011)