

N.I.C.O.L.A.S.

Oral Exam

March 25, 2020

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Non-invasive

Continuous

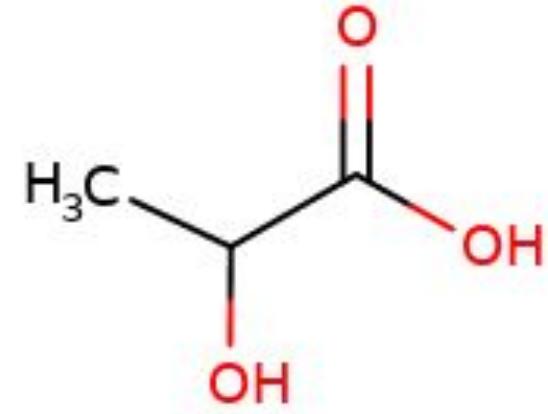
Optical

Lactic Acid

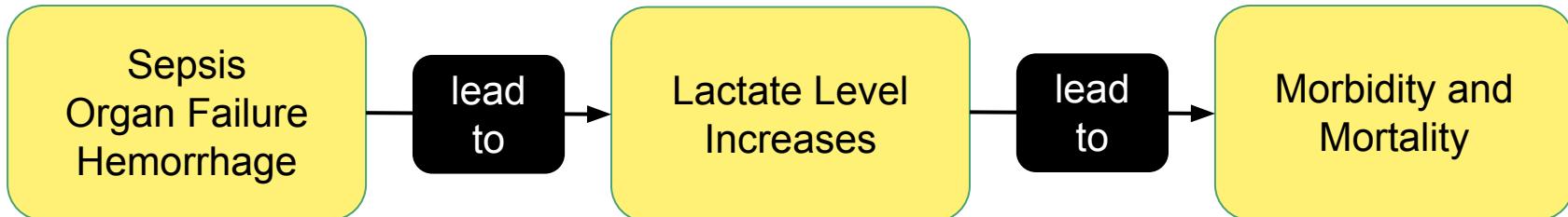
Sensor

Background

- Clinical biomarker used to measure tissue degradation
- Normal levels ~ 1 mM.
 - Relative > Absolute measurements



Lactic Acid
(2-hydroxypropanoic acid)



Problem Statement

- Currently, blood lactate levels are undersampled in clinical settings, leading to undetected spikes in lactate concentration which indicate the onset of sepsis, organ failure, and hemorrhage

Needs Assessment

Patient

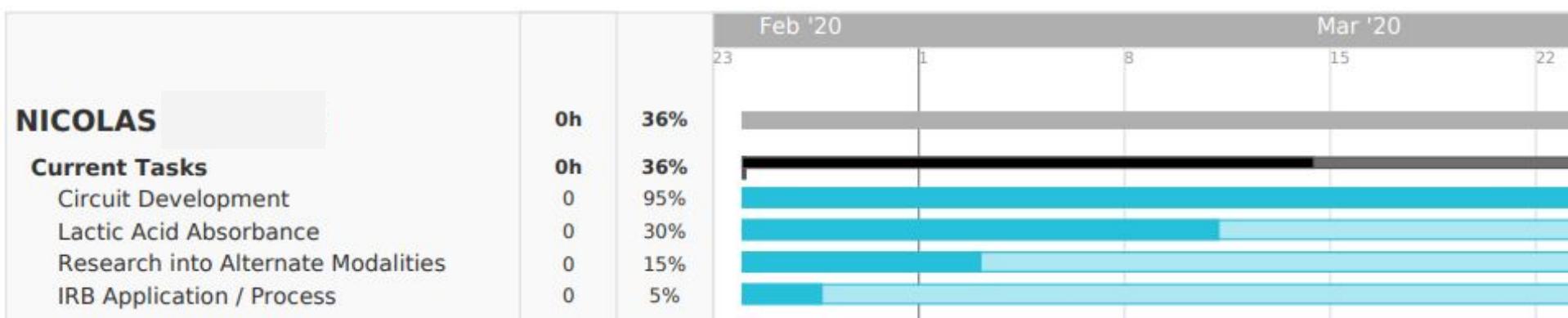
Insulated Device
Intermittent Pulses
Non-invasive

Practitioner

Continuous Sampling
Ease of Use
Clinical Application

System

Simplest Modality
Cost Effective & Portable
Integrate with Hospital Systems



Anticipated Failures

- Loose Connections between circuit connections and microcontroller
- Microcontroller issues
 - Turning on and off system
 - Indicating power is flowing through the system
 - Healthcare providers not knowing when system is on, off and recording
 - Microcontroller failure
 - Incorrect modulation of circuitry
 - Disconnection of microcontroller to display
- Calibrating Signal across
 - Correcting patient signal across finger orientation and other irregularities
 - Finger thickness
 - Weird growths in fingers that will disrupt signal transduction

Design Modifications

- Circuit Modifications
 - Addition of a manual on/off switch; initial design only controlled power from via microcontroller
 - Add LED that signals that photodetector/ LED is receiving power
 - Add LED battery level indicator
- Software Modifications
 - Use built in temperature sensor to monitor circuit temperature and automatically shut off power when temperature exceeds set maximum
 - Set up warning message to be broadcast if device reads null values (i.e. no reading because device has fallen off)
- Hardware modifications
 - Although we didn't get to fully mock-up what our final circuit mounting platform would look like, the finger clip and accompanying hardware platform must be able to adapt to patients of all sizes (excluding infants)

Safety Concerns

- Tissue damage by absorption -- microwaving
 - Finding optimal pulse rate to be able to measure lactic acid, while preventing tissue damage
 - Prevent pulse-rate from being too high to reduce short-term damage to skin
 - Prevent long-term overexposure by limiting frequency of measurement periods
- Packaging -- Overheating circuitry
 - Incorporating all of the specialized circuit components in a specific orientation, as well as packaging them into a small enough space for a finger clip
 - Ensure proper ventilation / prevent system overheating that could burn patient while wearing
- Sanitization / Sterilization capabilities
 - Designed in a way that enables routine cleaning, between patient usage