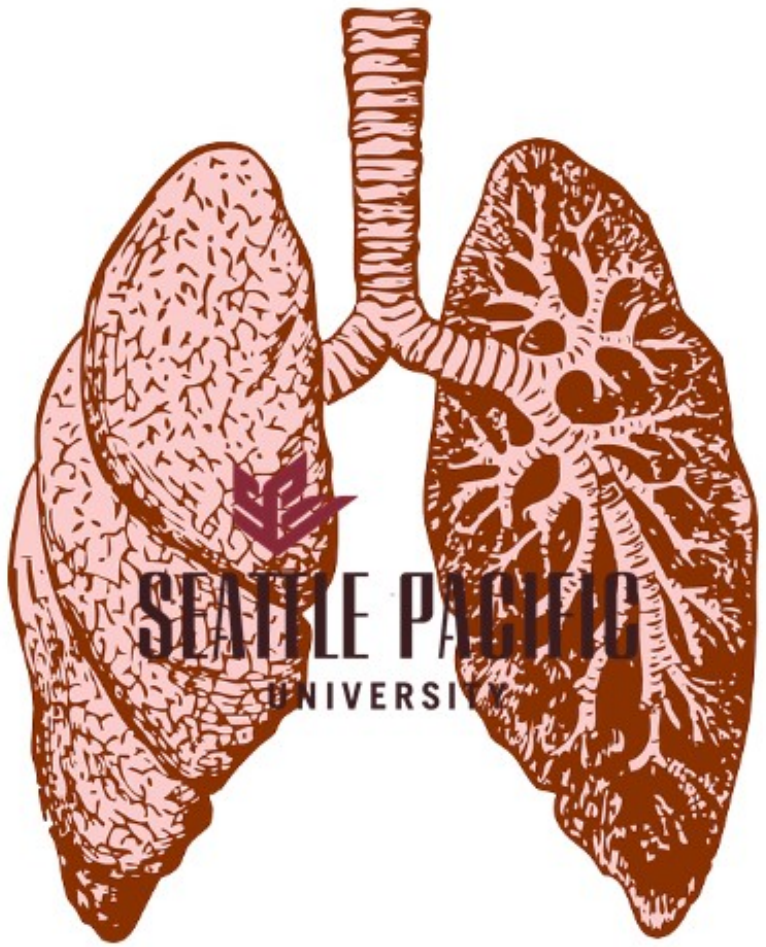

Incentive Spirometer 2.0: Modernize the Incentive Spirometer and add an OPEP function

Team Second Wind:

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Restoring Lung Capacity

Team Second Wind: Jason Smith (ME), Saihou Jobe (CPE), Makana Dang (EE),
Nathan Geller (ME), Omar Garibay (ME)

Objective:

- **To create a more incentivized and engaging device that allows doctors to track a patient's progress while also providing a secondary function that eliminates the need for a second device.**
- **Provide Lung Technologies in collaboration with Northwest Orthopedics in Spokane with a new, improved incentive spirometers.**

Concept:

Find optimized arrangement of components and features so that the product can be more beneficial and reliable, while also being cost competitive.

Approach:

- **Redesign aesthetic features to improve the look**
- **Study existing OPEP technology and integrate into system**
- **Create a system of self-regulating valves that open/close based on the direction of air flow.**

RRP and Analyses

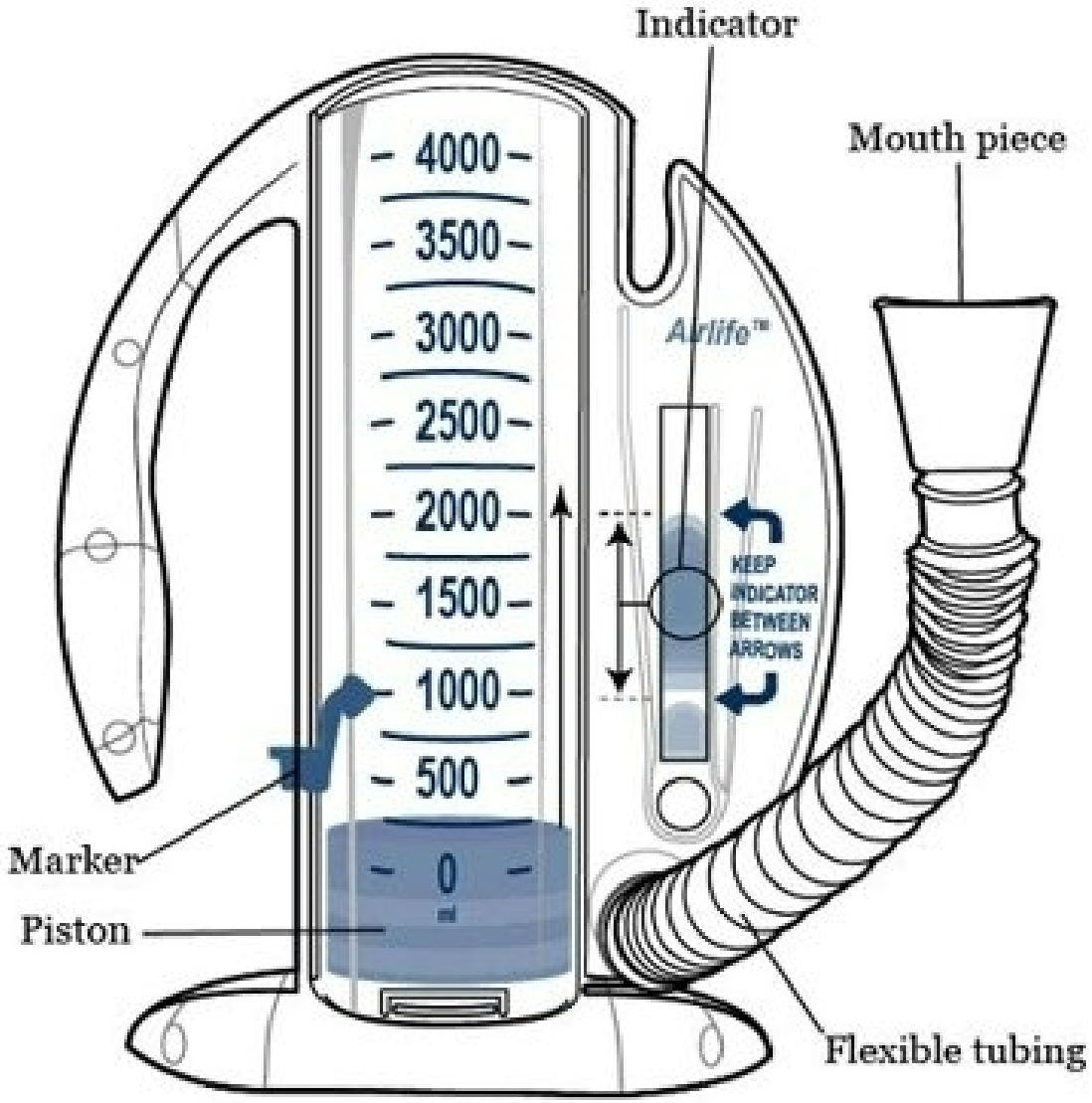
RRP

- **Use existing incentive spirometers as a basis for your product**
- **Build and test electrical components that are detachable and reusable.**

Analyses:

- **Perform SOLIDWORKS simulations for air flow. This will apply to the incentive spirometer and the OPEP components of the device.**

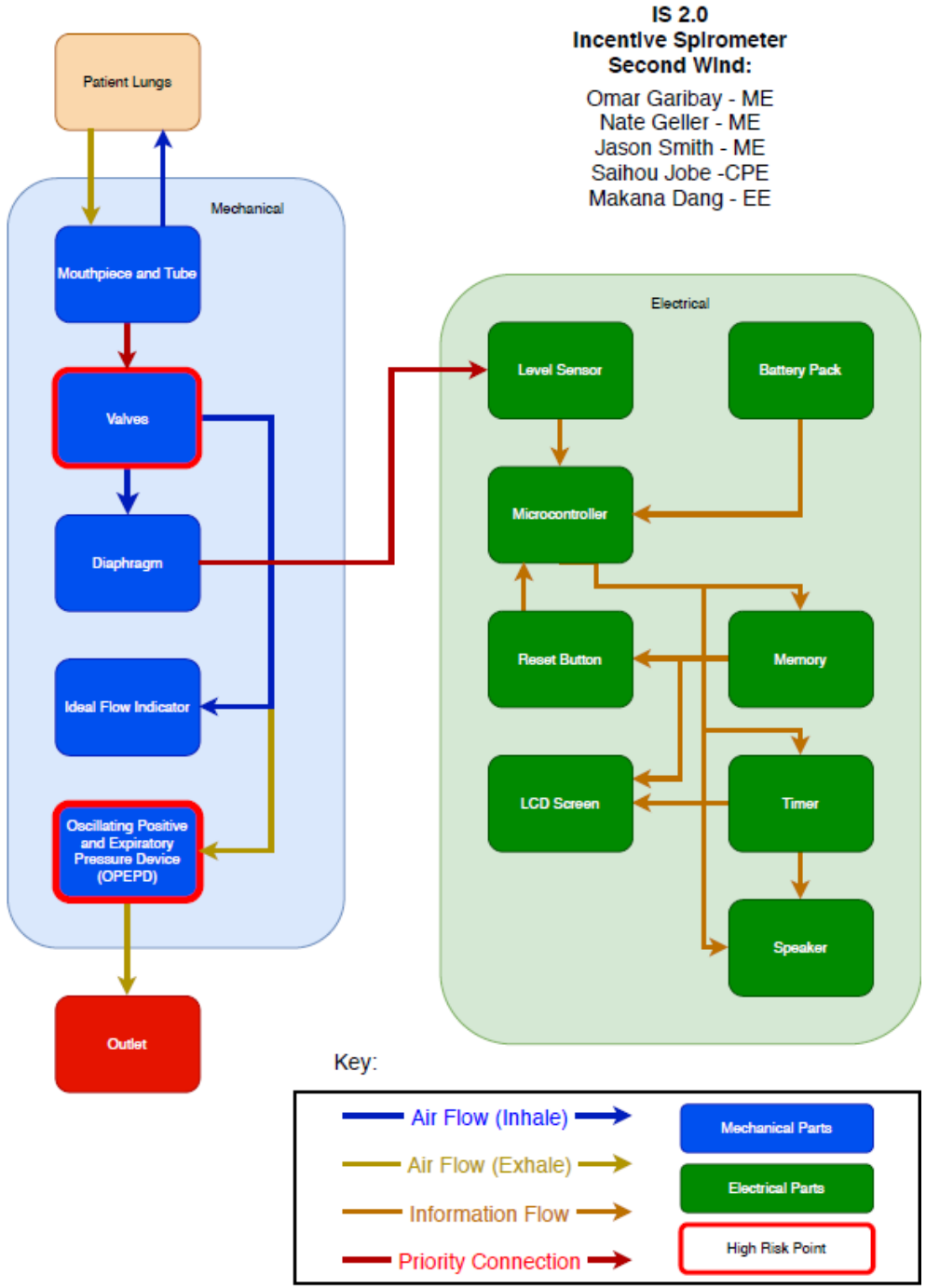
Spirometer Design



Problem Space and supporting research

- We need to reduce the cost on the healthcare system that results from post-surgical complications.
- Pulmonologist require reliable patient data obtained from the spirometer for high quality patient care.
- Integrated exhalation device to the spirometer reduces required real estate for medical devices in patient rooms.

Block Diagram



Critical path

THE INTEGRATION OF THE ELECTRICAL COMPONENTS WITH THE DIAPHRAGM.

VALVES TO DIRECT AND REGULATE AIR FLOW. (VALVES TO SWITCH BETWEEN SPIROMETER AND OPEPD)

THE SYSTEM TO VIEW RECORDED TESTS AND SUCCESSFUL INHALATIONS

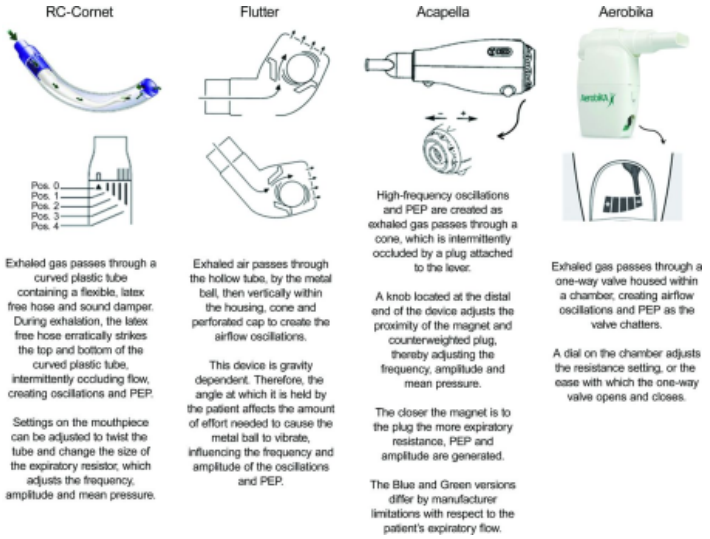
Q1 Specifications

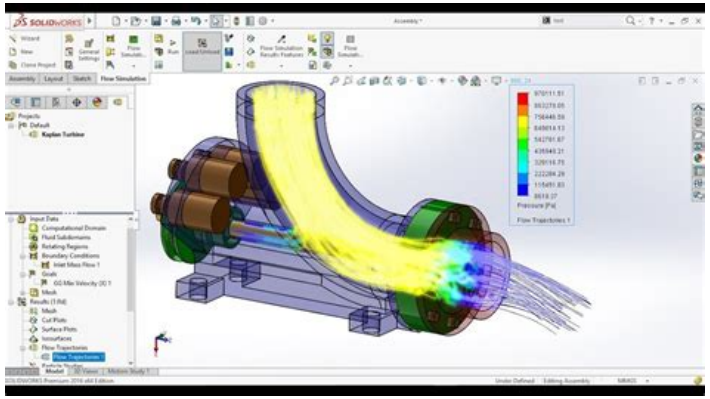
- How will we know if we were successful?

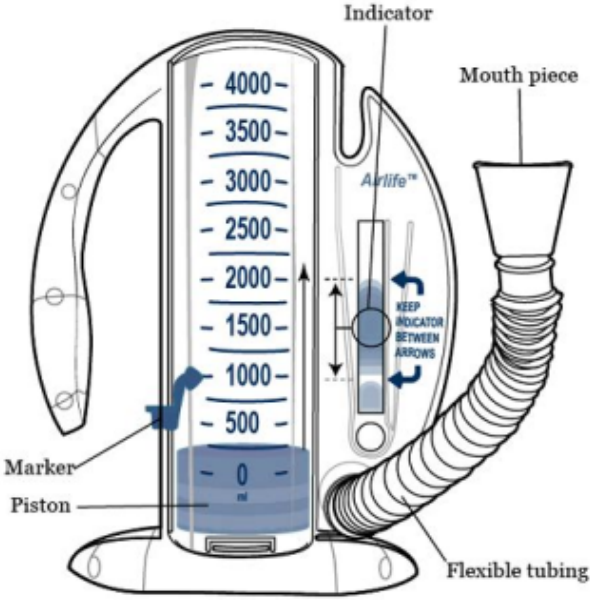
Spec ID	Requirement	Threshold (Shall)	Objective (Should)	Validation Method	Why this threshold value	Relates to critical feature(s)
RRP001	Proximity Sensor	N/A	Accurately record successful inhalation	Code output	Demonstrates ability to record when diaphragm crosses the target	1
RRP002	OPEP valve	N/A	Simple transition from spirometer to OPEP	Simulation and Experimentation	Demonstrates ability to switch direction air flow within the device	3
RRP003	Alarm system	Adjustable audio reminder to perform inhalation therapies	Adjustable audio and visual reminder on the LCD screen to perform inhalation therapies	Code Output and Testing	Demonstrates that the electronics can keep an internal timer on when the patient needs to perform their exercise.	2

Engineering Analysis

- We can use SOLIDWORKS's integrated flow simulators to study the effects of air flow in the system.
  - Valves
  - Air Pressure
  - Vents and Outlets
- Information storage
  - Data viewing
  - Data reset
  - Sensor interpretation
- Load Analysis
  - Battery Sizing
  - Load of each component





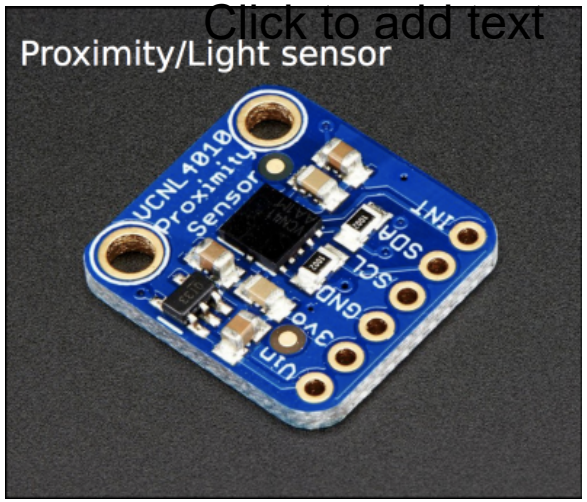


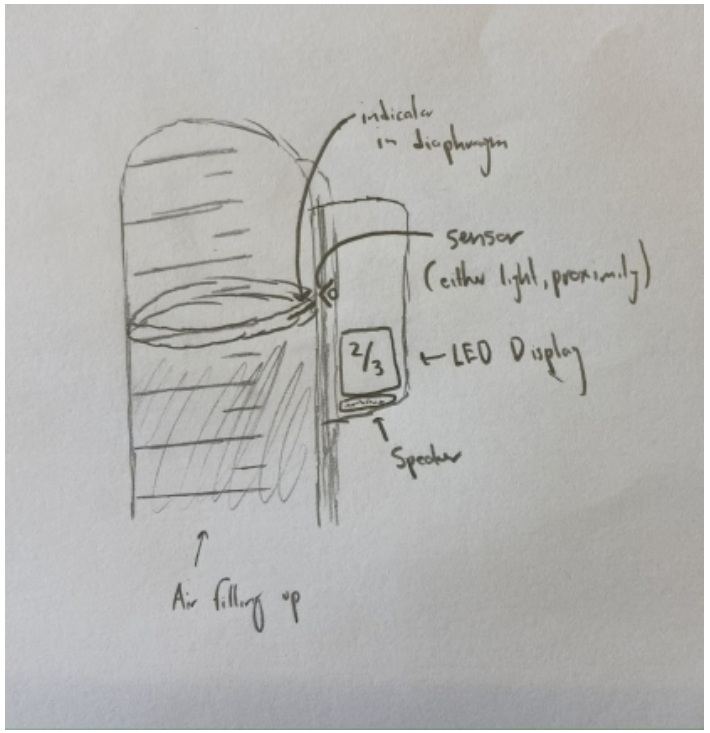
Proposed Critical Path: Mechanical

We will be relying on previous discoveries and inventions for the fundamental function of the device and its features. We seek to update the overall design. Using research papers, existing products on the market, and simulated 3D computer models, we will find the optimal selection of devices and integrate them into a singular device that serves the function of an incentive spirometer and an OPEP device.

Proposed Critical Path: Electrical and CPE

- Testing different sensors for the diaphragm position for recording SMIs
- Testing component loads to determine battery sizing
- Integration with microcontroller





Questions?