

Product Design Specifications: Infant CPAP Machine

Team Roles:

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Function: Preterm Infants are generally born with less surfactant in their lungs than full-term infants, resulting in more difficulty in keeping their lungs expanded. This can lead to chronic lung diseases which are often fatal for the infants, especially in developing countries where health care is severely limited. Continuous Positive Airway Pressure (CPAP) machines are commonly used to assist preterm infants in breathing, giving them a chance at a normal life. Our goal is to design and fabricate a CPAP machine that can be used in developing countries and at a cost significantly less than today's CPAP machines.

Client Requirements:

- Must cost no more than \$150
- Must use rechargeable batteries that run for longer than 10 hours
- Must provide continuous pressurized air (4-10cmH₂O)
- Must have a heater/humidifier to create safe air for the infant to breathe
- Must have an air-filter
- Must have a temperature and pressure sensor to measure values during treatment
- Must have an air exit valve to prevent air from recirculating after exhalation

Design Requirements:

1. Physical and Operational Characteristics

- a. Performance Requirements:** The CPAP machine must provide continuous pressurized air and the rechargeable batteries must last for at least 10 hours.
- b. Safety:** It must provide air that is at the correct pressure for the infant, at body temperature, humidified and filtered; otherwise the machine may be fatal.

- c. **Accuracy and Reliability:** The air temperature must be measured continuously and be between 36-37°C. The air pressure must be measured continuously and be between 4-10cmH₂O.
- d. **Life in Service:** Rechargeable batteries must last for at least 10 hours in a single use.
- e. **Shelf Life:** Storing the product will have no effect on its ability to perform.
- f. **Operating Environment:** This device will be used in developing countries around the world, mostly in Africa and South America. It should be operable in any environment, including patients' homes.
- g. **Ergonomics:** The device should be able to be operated by an untrained adult, but settings should be determined by a professional.
- h. **Size:** The device should be compact and easily portable. The Bi-Nasal prongs should have a diameter between 2mm-3.5mm and separated between 6mm-7mm.
- i. **Weight:** The device should be light enough to be lifted by a child.
- j. **Materials:** The device should utilize materials that can be found in the area it is used in.
- k. **Aesthetics, Appearance, and Finish:** Not applicable.

2. Production Characteristics

- a. **Quantity:** Our team will be developing one CPAP.
- b. **Target Product Cost:** The cost should be significantly less than current CPAPs. Our device should cost \$150 as compared to \$500.

3. Miscellaneous

- a. **Standards and Specifications:** The device should utilize the same concept as current CPAPs, but with cheaper material.
- b. **Customer:** The client wants the design to cost significantly less than current devices and utilize rechargeable batteries, making it operable in any environment.
- c. **Patient-related concerns:** The device should be sterilized when switching patients. The device should be comfortable for the patient. Pressure and temperature readings should be carefully monitored.
- d. **Competition:** CPAPs are a common instrument used in developed countries, but not where health care is severely limited. Our device will be able to be used anywhere.