Portable pneumatic pump to support chest wall ventilation in the newborn

Overview
Respiratory Distress Syndrome (RDS) affects nearly all infants born prior to 28 weeks of pregnancy, and, for those afflicted in the developing world, there is a 90% mortality rate. Current positive pressure ventilation methods for assisting neonate respiration are damaging to the infant’s lungs and trachea. In addition, current solutions are too costly for widespread use in developing countries.

Objectives
The purpose of this project was to design a portable pneumatic pump that assists neonate respiration by inflating and oscillating a set of pressure cuffs attached to the infant's chest wall, thereby expanding the chest and allowing air to move within the lungs. In addition, the pump must have controls for the manipulation of the frequency and amplitude of oscillation, as well as the total pressure output.

Approach
- An introductory meeting was held with the sponsors to gain a better understanding of project expectations and establish a list of customer needs and/or requirements
  - Additional weekly meetings were scheduled to update the sponsors, establish any changes in project expectations, and gather needed data/ engineering specifications
- Using literature provided by the sponsor, as well as individual research into existing products and patents, team members developed a list of concepts that could be used
- Each concept was presented to the rest of the group and the top three were ranked for their ability to meet the customer needs using a Pugh Concept Scoring Matrix
- The selected concept was modelled three different ways using SolidWorks
- A prototype was made by connecting the inner components and placing them within a casing manufactured using Plexiglas and a laser cutter
- The prototype was tested for its ability to meet customer needs by plotting the pressure output against time using a pressure transducer
  - The generated waveforms were evaluated for maximum and minimum pressure values as frequency and amplitude of oscillation, as well as pressure output, were manipulated on the pump interface
- The size, weight, and noise output were assessed using a ruler, scale, and Decibel 10th Noise Meter app, respectively
- The ease of use was assessed by having randomly selected individuals operate the pump after 10 minutes of training
- Results obtained from testing were analysed to determine if they met the original specifications outlined by the sponsors

Outcomes
- This product is less damaging to neonates, requires less training to operate, and costs over $30,000 less than current devices on the market used to treat RDS
- This is the only pump of its size capable of providing a mean airway pressure and an oscillating pressure