Sensorpump

A “field"-deployable, fluid infusion system that will decrease pre-hospital mortality and postoperative organ failure from hemorrhagic shock.

Ivan-Thibault Pham, M.Sc. Mechanical Engineering and Applied Mechanics Candidate

Business Opportunity

Background: Hemorrhage remains the primary potentially preventable cause of death on battlefields and the second leading cause of death in civilian trauma [1,2]. Unfortunately, an estimated 56% of deaths occur during the pre-hospital period and 50% of patients died within 24 hours after admission as a result of hemorrhagic shock (HS) [3,4]. Although 20% of deaths after HS are considered as avoidable [6]. Hemorrhagic shock is a life threatening condition which often requires immediate fluid infusion to replace lost blood and re-establish adequate delivery of oxygen to tissue.

Problem: In mass casualty incidents, where traumatic injuries and hemorrhagic shock is commonplace, first responder and other healthcare personnel may have difficulty maintaining correct fluid infusion rates for individual patients in hemorrhagic shock. Lack of attention or incorrect infusion rates may cause severe on site injuries and prehospital death, or delayed post operative complications.

Solution: A "field"-deployable, automated, infusion system that will decrease prehospital mortality and post operative organ failure from hemorrhagic shock by providing accurate automation of the fluid infusion rate.

Product

The proposed device, gives healthcare personnel the ability to semi-automate IV fluid infusion, allowing them to tend to multiple patients. By utilizing a set of modular sensors to measure factors such as blood pressure, temperature, and electrical activity of the heart, the level of hemorrhagic shock will be provided. Another set of sensors will monitor and control the flow rate of the pump dispensing the IV bolus. If the patient's vitals indicate that the hypovolemia is getting worse, the pump will speed up the dispensing, if the vitals are stabilizing, the pump will slowly ramp down fluid infusion. Finally, if the sensors detect signs of hypovolemia, such as a very low blood pressure, the pump will switch off and notify the user. These monitoring and automation features, unique to this concept, will allow the pump to emulate some of the actions of a paramedic: measuring vitals and regulating the IV flow. They will also allow the user to be able to focus on other tasks or patients while receiving audio notifications and critical feedback on the status of their patients.

This is a novel concept that will fill a much needed gap in emergency medical technology, no such product is currently on the market.

Overview of Market

-Civilian first responders

- Over 1 million firefighters in the United States, of whom approximately 750,000 are volunteers.
- Local police departments have an estimated 556,000 full-time employees including about 436,000 sworn enforcement personnel.
- Sheriffs' offices reported about 291,000 full-time employees, including about 186,000 sworn personnel.
- There are over 155,000 nationally registered emergency medical technicians (EMT).

-Military

This device also has applications in the military sectors, as it could be used by medics and other healthcare personnel on the battlefield and field hospitals. Further market research needs to be conducted to evaluate the size of this target population.

-Healthcare professionals in underserved locations

This product can also be used by healthcare professionals in third world countries or other underserved population, where the community cannot afford the cost of many healthcare professionals or expensive device. This target population can be primarily reached through non-profit organizations such as GlobalMedic and Medecins Sans Frontieres (Doctors Without Borders). Further market research needs to be conducted to evaluate the size of this target population.

-Mai**n competitor**

Zoll Power Infuser Fluid Resuscitation Pump: Portable fluid resuscitation device developed by Zoll in cooperation with the Walter Reed Army Institute of Research. However, this device has no intelligent sensor monitoring and response package like this proposed design. It only utilizes a static flow rate that is user adjustable by dial; while only containing basic pressure and air feedback sensors.

Development Plan

The development of the product will be conducted in 4 phases:

Phase 1) Product definition: Concept development, end user concept evaluation, and develop design requirements. (2 months)
Phase 2) Develop prototypes, and verification and validation (4 months)
Phase 3) Regulatory submission (varies)
Phase 4) Manufacturing (ongoing)

Expected development cost:
Parts: 1 Alpha prototype, 1 Beta prototype, and extra parts= 3*500 = $1,500
Salary: 2 Product Development Intern: (20 hrs/week)*($10/hr)*(6 months)= $9,600
Total projected development cost=$11,100

Expected device cost <=$500 (from proof of concept development)

Bio

Ivan-Thibault Pham-

Role: Founder, CEO, and Product Development Engineer

Education

M.Sc. Mechanical Engineering and Applied Mechanics Candidate (Spring 2016)

B.Sc. Biomedical Engineering, Georgia Institute of Technology (August 2013)

Work Experience

Design Science Consulting- Human Factors Researcher