Sternheimer Application Packet
Team Lima (BME 110)
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Feedback Device for Orogastric Feeding System

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Abstract

There are major clinical problems with the current enteral feeding systems in use at the VCU health system and at other hospitals around the country. These problems create unnecessary costs, add time for unplanned tasks to the care partner’s schedule, and most importantly, they create biosafety issues, leaving nurses at a high risk for being exposed to bodily fluids of the patient.

The current system utilizes a peristaltic pump to bring the tube feeding to the patient by an orogastric tube. To assess digestion of the nutrients by the patient, there is a process whereby the contents of the stomach are brought in the reverse direction of the system into a syringe. The nurse measures the volume of the contents and then uses the syringe to bring the contents back to patient via the orogastric tube. This mechanism happens through a valve called the Lopez valve. The problems occur when the nurses do not properly configure the device. When the valve is in the incorrect position, back pressure arises and the tubes come out of the valve leaving a mess of gastric contents on the bed as well as on the nurse and patient. Spilling also occurs when attempting to remove or replace the gastric contents with the syringe. These are major biosafety issues, as the nurse is exposed to potentially contagious fluids from the patient and must then get tested for any diseases. Spills because of the mechanism lead to bed changes, which take away time from other patients that the nurse can be attending to and also cost the hospital money. Another cost is incurred by the hospital when the nurses have to be tested for diseases because of interactions with the bodily fluids of the patient. Spills or mishaps caused by interaction with the system occurs at least twice a day just in the Medical Respiratory Intensive Care Unit at the VCU hospital. Since the Lopez valve is widespread in many units in hospitals across the US, the negative impact is vast. Currently there is no suitable solution.

The goal of this project is to create a device that will make the enteral feeding system more unified, safe, and time-efficient. To do this, we plan on automating the process that causes the problem, the assessment of digestion. Our design will feature a peristaltic pump that moves fluid back and forth from the stomach, a closed off container to house the contents and measure the fluid by eye, a sensor to measure the fluid electronically, a screen to display the amount measured by the sensor, a microcontroller to control the detection and relay the data to a screen, batteries to supply power to microcontroller, and buttons to easily switch between on/off and forward or backward flow. The system will be housed in order to avoid contact with the environment, but also easily integrated into the currently used IV pole system and with the currently used medical tubing. The system will reuse many of the components between different patients, but anything that comes in direct contact with the patients like the tubes and containers will be replaced with every new patient.

For our prototype to be successful, it will need to accomplish the following deliverables: controls flow in different directions while minimizing contact with external environment, accurately measures volume; significantly reduces problems of spilling, leakage, and back pressure; and provides compatibility with features of current feeding system.

The process of completing this project would involve rigorous testing to determine suitable tubing measurements, flow rates, and fluid pressure build-up. There would also be simulation testing with nurses to determine if the design actually solves the biosafety, time, and cost problems associated with the current system. After reviewing and analyzing the test results, the prototype will be modified to its final version.
The table above shows the current line-item budget for our project with a final total of $560.46. All items in this budget have been deemed necessary to the success of our prototype, either as a part or for assembling or testing. The most expensive parts to our project include the medical tubing, the IV pole system, and the pump, and are deemed as one-time purchases. However, it is inevitable that we will need more money, especially next semester during the revision process of our prototype. As revisions occur, we will need to buy more parts, either due to failures or design revisions, potentially going over the budget. Potential qualitative and quantitative testing could also stress the materials used resulting in having to buy new materials. The 3D printing cost is an estimate, because we are not yet far enough in the building process to know exactly how much the parts will cost to 3D print.

These potential added costs may add up to $100 to our project budget. The current budget also shows that we are $60.46 over our allotted budget. Considering all of this, we request $160.46 in additional funds to support the successful completion of our project.
Figure 1. Image of Final Design. It features the measurement container, the peristaltic pump, the distance sensor, the microcontroller, the tubing, the medication port valve, and the feeding solution.