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Objective: Develop a smart-shunt concept and design for hydrocephalus treatment that detects and communicates intracranial pressure changes of 2-5 mmHg by measuring the pressure both inside the shunt and at the tip inside the third ventricle.

The first and most critical problem our team is facing is how exactly to measure this pressure through an inconspicuous, biocompatible and reliable device. We have been conducting research on different pressure sensing mechanisms and assessing the feasibility of each for our design:

1) Telemetric intracranial pressure transducers
2) Colorimetric pressure sensing film containing microcapsules which qualitatively depict pressure through color change in the form of topographical images
3) Intraocular pressure sensors, which could be easily modified for use in the CSF shunt design. Our team has also identified sensors which can be permanently inserted and remotely monitored through external detector coils which pick up the resonant frequency of the LC circuit
4) Piezoelectric pressure sensors
5) Carbon nanotube based membranes which deform under pressure and could be placed at the tip of the catheter to detect growing pressure differentials between the ventricle and shunt
6) Differential optical fiber pressure sensors

Our team will meet Dr. Feldman on January 29th to discuss the pressure detection methods we have researched. This discussion will center on the limitations and considerations for each method on the clinical application side of the problem. Our team is leaning towards use of intraocular pressure sensors, which are already appropriate for biological use, and hopes to converge on one pressure sensing mechanism in the next week, which will be tested and simulated.

As a next step after selecting a pressure sensing mechanism, our team will need to test its performance and suitability to hydrocephalic shunts. For this, we will develop a physical model of the system, which presents a whole new set of challenges to overcome. The primary challenge lies with developing an appropriate timescale for the model. Since VP-shunts usually fail over the course of two years, adequately controlling flow and protein concentration of the model fluid such that a two-year blockage can be accurately modeled within a one week timespan is a considerable challenge. Due to the complexity of hydrocephalus and VP-shunt directed CSF drainage, a simplification of the overall condition, for the purposes of the model, is necessary. In order to accomplish this, we will discuss the minimum requirement for the parameterization of the model with Dr. Feldman in our upcoming meeting.