

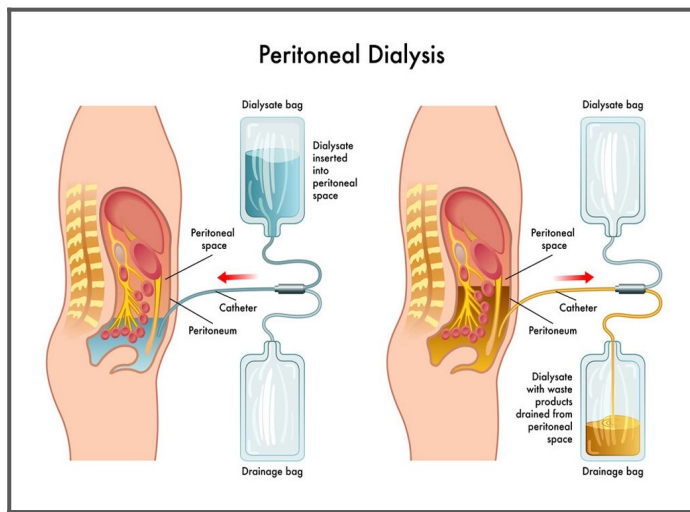
Portable Peritoneal Dialysis Machine

BMEN 3151 Medical Device Practicum

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Clinical Problem

People suffering from kidney failure need to regularly undergo dialysis throughout their lifetime. Peritoneal dialysis is a form of dialysis that utilizes the peritoneum in the patient's abdomen as a natural filter. There are two types of PD: Continued Ambulatory Peritoneal Dialysis (CAPD) and Continuous Cycling Peritoneal Dialysis (CCPD). CAPD requires 3-5 exchanges of dialysate solution every day each taking about an hour and CCPD requires 12 hours of continuous exchange of dialysate solution every day. Even though PD allows patients to receive treatment at home unlike hemodialysis and provides patients with statistically better outcomes, both types of PD require are still very restrictive as the patient must remain in the same position while the exchanges take place. Allowing mobility during exchanges will aid in patient compliance and mental health.

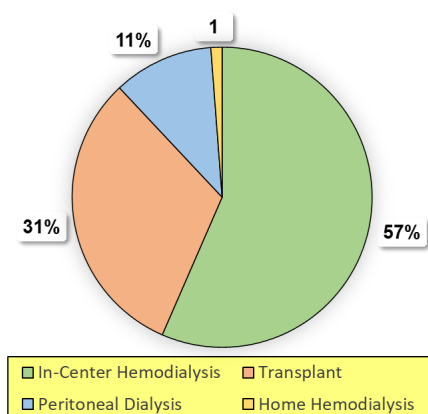


Needs Statement

Patients suffering from kidney failure need a less restrictive peritoneal dialysis device to increase patient compliance, mobility, general life quality and decrease morbidity.

Market Analysis

End-Stage Renal Disease (ESRD) prevalence reached an all-time high of 2,317 cases per million people in 2018 in the U.S. Since 2011, year-over-year increases in unadjusted ESRD prevalence have been at or below 3%. In 2018, The number of peritoneal dialysis patients increased to 58,636, representing 7.7% growth since 2017. Peritoneal dialysis patients make up about 11% of all dialysis patients. There is a growth potential for this treatment modality, if better medical solutions are provided. Medicare provides health coverage for those with End-Stage Renal Disease (ESRD Medicare) if the patient have permanent kidney failure that requires dialysis or a kidney transplant. Total "liabilities" (expenditures plus patient responsibilities) increased from \$40.9B in 2009 to \$49.2B in 2018 – 20.3% overall, about 2.1% per annum. Fresenius Medical Care and DaVita has approximately 77% market share in the United States.

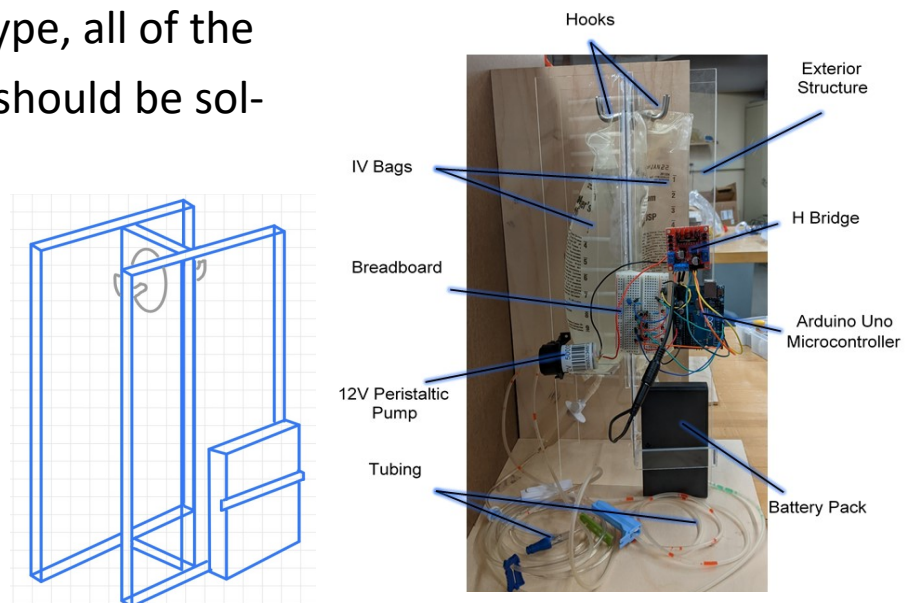
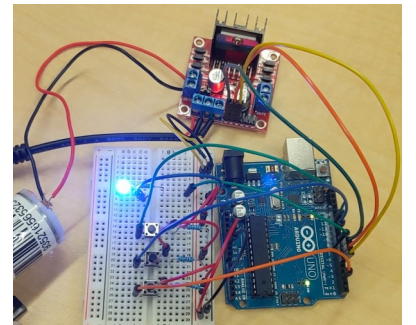


Medical Device Solution

The proposed solution was a wearable device that would carry out the peritoneal dialysis, allowing the patient more mobility, and increasing their quality of life. The patient will be able to wear the backpack and perform dialysis while participating in normal daily life activities.

A peristaltic pump was implemented to avoid using the typical mechanism for CAPD, gravity. An H bridge driver was used to control the direction of the pump flow. The setup is controlled by an Arduino Uno, and is powered through a set of eight 1.5V cells. Two 1000 mL IV bags were hung on the structure with two stainless steel hooks. The exterior structure of the first prototype was made out of fiberwood. The final prototype was made out of waterproof acrylic.

Further improvements on the current prototype may include a moisture sensor that will turn off the device automatically if moisture is detected at the electronics side, and an air bubble sensor to prevent air embolisms. The current device is powered by a battery pack. A rechargeable battery where the charging port is on the outer side of the backpack will be more convenient. A faster and easier way to attach and remove the IV bags should be implemented. For the final prototype, all of the electronics should be soldered on a PCB board.



Team Photo

