Department of Mechanical Engineering
THE UNIVERSITY OF UTAH

IV POLE REDESIGN

The University of Utah

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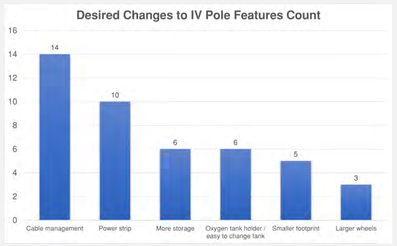
INTRODUCTION

There is a constant need to improve the safety of medical equipment in the United States. In response, our group identified the IV pole as a potential candidate for equipment in need of change. Based on anecdotal evidence, we believed that the IV pole wheelbase was a significant cause of tipping and tripping hazards in medical facilities. The execution of the project was accomplished through the following:

- Initial survey conducted at the Huntsman Hospital, In-patient Oncology.
- Use the results to drive the direction and focus of the design.
- Conduct an iterative design process to refine.
- Conduct testing to ensure the final product complies with UL-60601 and meets design specifications.
- Conduct tolerance stack-ups and produce engineering drawings.



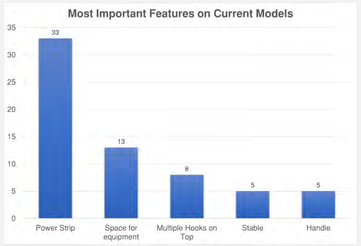


Figure 1. Results from a survey conducted at the oncology department at the Huntsman Cancer Institute. Desired changes (left) , and the most important features should be implemented in the design (right).

OBJECTIVES

1. Design an IV pole that solves cord management and provides extra plugs.
2. Integrate cable and tubing management into one complete assembly.
3. Ensure cable/tubing management system reduces pole tipping hazard.
4. Create a breakaway power cord that stops the pole from tipping when snagged.

DESIGN METRICS

Table 1. Table of design metrics and corresponding values.

Metric	Specification	Unit	Value/Range
1	Available Power	Watts	0-144
2	Number of Receptacles	Each	5
3	Cord Management	Meters	30
4	Pole Diameters	Centimeters	1.5 - 3.2
5	Breakaway Force	Newtons	9-22

DESIGN COMPONENTS

1. **Outlet housing:** Contains the outlets and electronic components. Compatible with IV pole diameters between 1.5 - 3.2 cm.
2. **Cord Wraps:** Two cord wrap assemblies are used to manage cable and IV lines. Their placement on the pole can be easily changed to accept various lengths of cable.
3. **Breakaway Plug (Male):** Connects to the wall outlet and remains plugged in when the magnetic connection is broken.
4. **Breakaway Plug (Female):** Attached to the cord of the outlet housing. The magnetic connection between the plugs breaks away when someone trips on the cord, preventing the IV pole from falling over.
5. **V-blocks:** provide a secure connection to the pole.
6. **M6 x 70 mm SHCS:** Fasteners used for the clamping mechanism on the housing and cord wraps. An inset nut in each of the devices adds an economical and durable thread to the plastic components.
7. **Knobs:** Pressed onto the SHCS fasteners and aids with easy device installation.

Power and Cord Management System

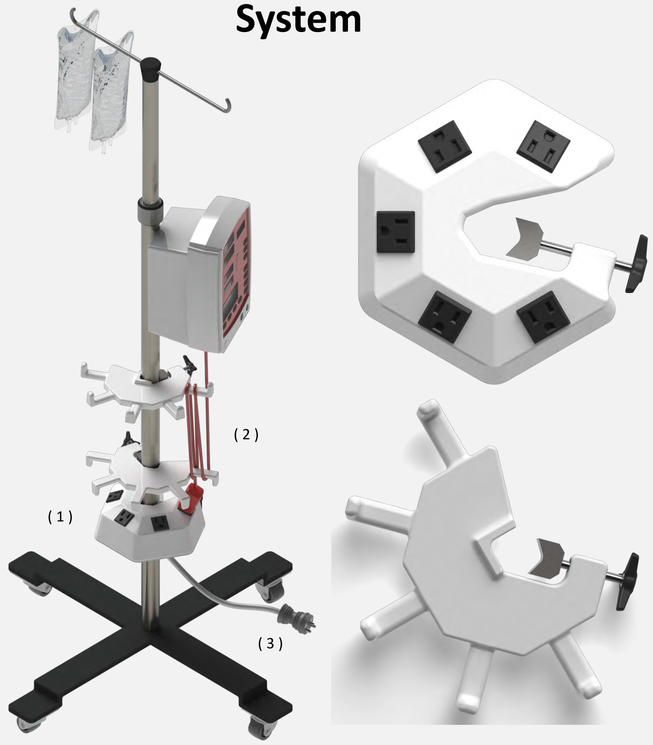


Figure 2. CAD model of final prototype. The outlet housing (1) provides power to devices mounted on the IV pole. Cord wraps (2) keep excess cord organized and out of the way. The breakaway plug (3) reduces the risk of tip over accidents.

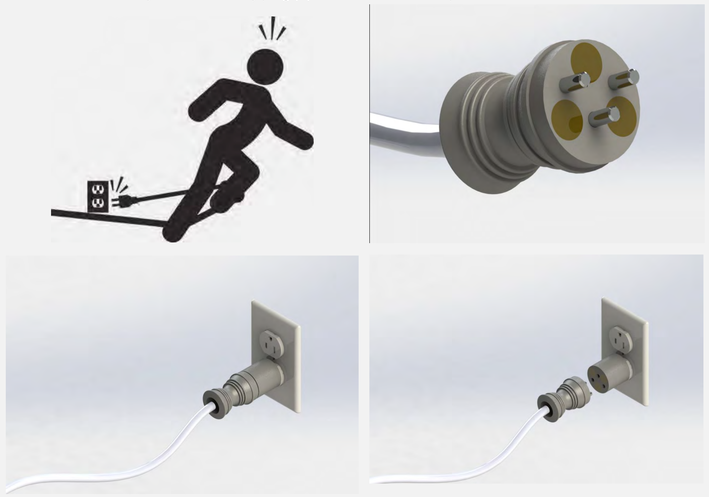


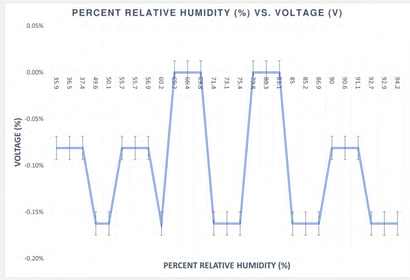
Figure 3. Magnetic breakaway power cord from power strip which unplug when pulled under specific amount of force to reduce tripping hazards. The magnetic breakaway is a feature that many attachments in the market do not have.

RESULTS

The new ergonomic design allows medical personnel to manage power cords without bending over by angling the receptacles upward removing the need to bend over to plug-in devices. In addition, the cord wraps provide a means of wrapping excess cables and tubing to prevent them from dragging on the ground and tripping the pole. The cord wraps and power strip are adjustable to accommodate varying IV pole setups seen in different medical settings.

The updated IV pole power strip passed testing required under UL-60601. Specifically, testing environmental conditions to ensure that the housing maintains consistent power output while varying temperature between 20°C - 40°C and humidity between 30%-100%. In addition, GD&T and tolerance stack-ups ensure that the product will be manufactured at scale with minimal assembly issues.

A final survey conducted by the nursing manager of the floor, and the results were that attachment manages cords excellent, and the attachment easy to clean, handle day-to-day medical devices, and has visual appealing design were above average. The scale grading from the survey is poor, below average, above average, and excellent.



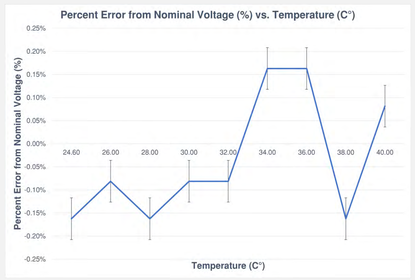


Figure 4. Results from environmental testing. Error bar plot of humidity vs. voltage (left), and temperature vs. voltage (right).

CONCLUSION

Our prototype provides enhanced safety and usability improvements over currently available hospital-grade power strips. The device provides power for up to five medical devices, with surge protection and a LED that indicates when the device is in use. The cord wrap system bridges a gap between current designs by neatly managing the power cables from devices attached to the pole - reducing clutter and tripping hazards. The cord wraps can also be used to manage excess lengths of IV tubing by allowing medical staff a hang tubing during transit.

The magnetic breakaway plugs on our device further increases the safety of patients and healthcare workers by preventing trip and tip related IV pole accidents. If staff or patients are moving the pole and forget to unplug the power cord, the cord breaks away before enough force is generated to cause tipping.

At this stage, our device is still a prototype and needs refinement before it is ready for production. However, the concept we developed has been reviewed by medical personnel as a meaningful solution. Our design offers safety and organization improvements for using IV pole mounted devices in healthcare settings.