

Nuha Mirza¹, James Virtucio¹, Joie Chen¹, Natty Lapinsky¹, Terry Coley¹, Shayla Murray², Rudra Amin², Trevor Tran², Margot Bellon², Katherine Jerakis², Timothy Niesen, MD³

¹ School of Biomedical Engineering, Science, and Health Systems, Drexel University, Philadelphia PA ² Drexel University College of Medicine, Philadelphia PA ³ Christiana Care Health Network

Need

Every year, millions of Americans return home from surgical procedures with drain bags. Managing these drains, once handled by healthcare professionals, then falls on the patient or their family member, adding stress to an already overwhelming recovery process. The Philly Y was born out of feedback from physicians that their patients would benefit from a more straightforward adaptor model, eliminating any potential for misuse. Simplifying drain care is crucial to reducing complications and minimizing costly health outcomes during recovery.

Objective

The Philly Y is engineered to replace traditional three-way stopcocks in surgical drain systems, **enhancing safety, efficiency, and patient comfort**. The product **optimizes drainage performance** while facilitating ease of use.

Existing Solutions



A three-way stopcock is the current industry standard for post-surgical drain kits. Maneuvering this device can be complicated for patients and their caregivers at home. Improper flushing leads to a collection of debris and an increased risk of infections. A three-way stopcock is also relatively large and can be uncomfortable for patients wearing their dressing 24hrs a day.

Design Inputs

Constraints

- **Time:** ~30 Weeks Max (Fall, Winter, Spring Term)
- **Budget:** \$500 (DrExcel Health)
- **Resources:** School of Biomed, DrExcel Health
- **Policies:** School of Biomed, DrExcel Health, Healthcare/Medical Env.
- **Valve Connection Diameter:** Adult Men: 14FR - 16FR (4.62mm - 5.28mm), Adult Women: 10FR - 12FR (3.3mm - 4mm), Children: 6FR - 10FR (2mm - 3.3mm)
- **Valve Connection Style:** Luer lock diameters
- **Biocompatibility:** Biocompatible materials

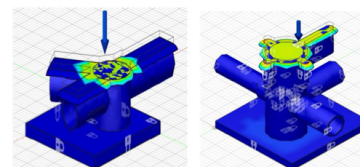
Requirements

- 1) **Configuration Complexity Reduction:** Minimize operational configurations for ease of use; reduce process to 5 steps
- 2) **Contact Pressure Comfort:** Minimize contact pressure to enhance user comfort
- 3) **Pressure-Drainage Rate Curve:** Maintain effective drainage across a range of internal pressures
- 4) **Leakage Prevention:** No leakage under internal pressure

Verification/Validation

Contact Pressure

$$P \leq 5.2 \text{ kPa}$$

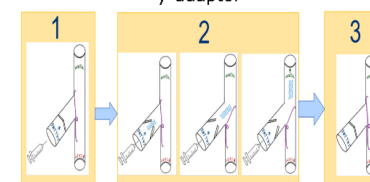


$$P_{Y\text{-adaptor}} = 2.07 \text{ kPa}$$

$$P_{\text{current}} = 5.13 \text{ kPa}$$

Complexity Reduction

$$\text{Steps}_{Y\text{-adaptor}} < 5$$



3 steps < 5 steps

Flow Rate*

$$Q_{Y\text{-adaptor}} = Q_{\text{Current}}$$



$$Q_{\text{Current}} = 72 \text{ ml/min}$$

Leakage Prevention*

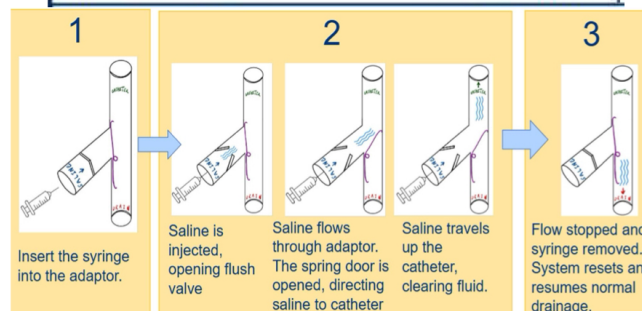
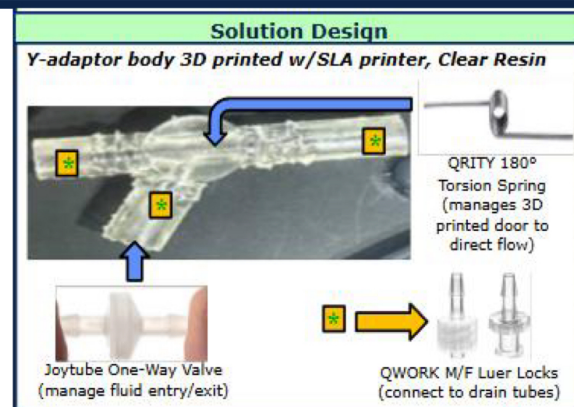
5 Flushes w/o leaks @ 41.4 kPa (6 PSI)



Current:
5 Flushes
w/o Leaks

*Only tested Current Adaptor so far to set baseline

Prototype



Conclusion and Impact

The Philly Y surgical drain Y-adaptor is designed to **enhance patient comfort** while facilitating **more efficient and user-friendly** flushing of drainage systems as an alternative to current three-way stopcock surgical drains. This innovative drain can lead to a **reduced risk of post-surgical infections** due to drain misuse and **improve post-surgical outcomes**.

Financial Market

The current surgical drain device market is valued at **\$2 billion** globally (TAM) and **\$773 million** in North America (SAM). The goal for the first year is to focus on targeting academic hospitals and outpatient surgical centers in the Northeast region with a SOM of **\$480k** (0.2% of US market). Global market growth is projected to grow to **\$3-4 billion** by 2030.

Acknowledgements:

- Dr. Adrian Shieh, Dr. Wan Shih, Dr. Sarver, and Dr. Dougherty
- Dr. Timothy Niesen
- Steven Kurtz and James Smith