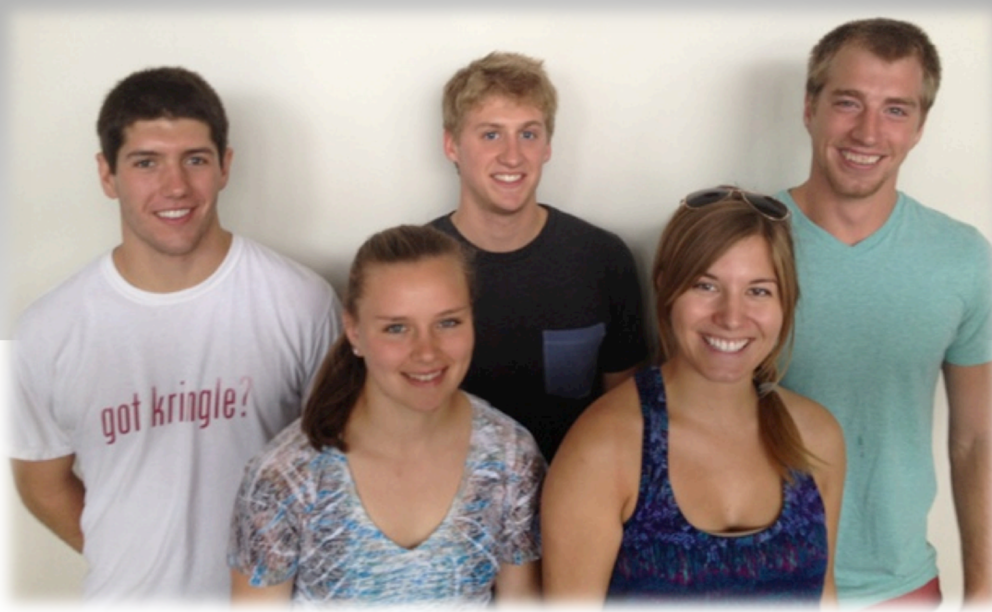
Expandable Nasogastric Tube



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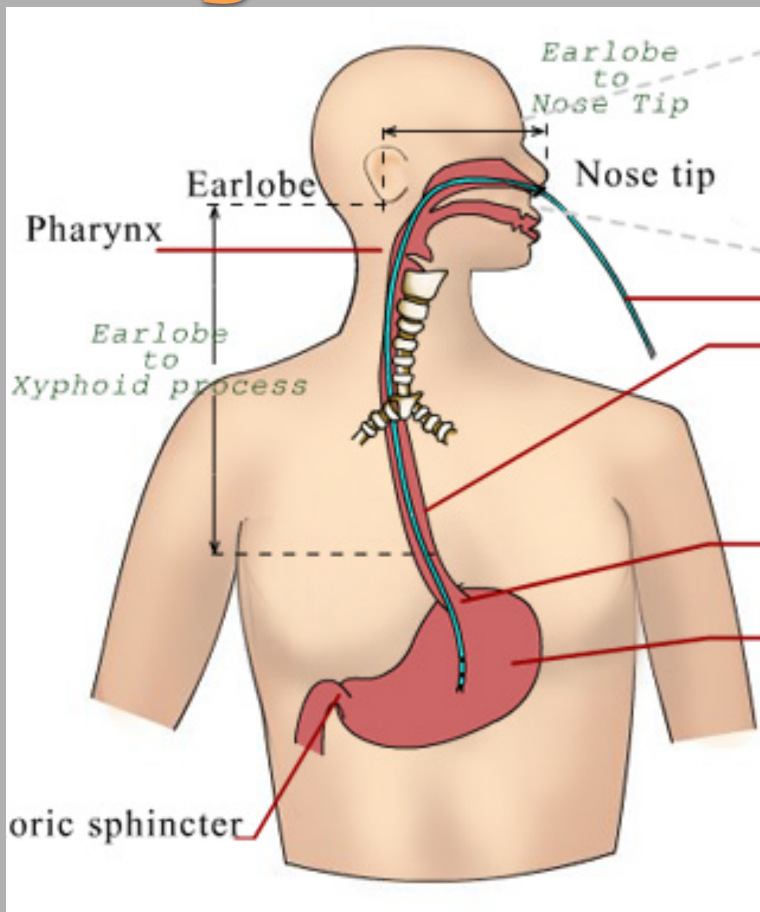
Client: Dr. Steven Yale
Advisor: Paul Thompson

Presentation Overview

- Background
- Problem Statement
- Existing Devices
- Client Requirements
- Design Alternatives
- Design Matrix
- Final Design
- Future Work

Background



- Aspiration of gastric contents
- Gastric decompression
  - Special channel
- Inserted through nose
  - Navigational process
- Premeasured
- Can stay in patient for extended period
  - Attached to patient

Problem Statement

- Large gauge tube causes discomfort for patient
- Sufficient physician skill is required for proper insertion
- Need for X-ray adds medical costs
- Outdated with readily available medical resources

Current Devices

- 2 Lumen – Venting and Suction Drainage
- Made of PVC, PU, or Silicone
- 12-18Fr (4-6mm)
- Radio opaque strip
- Closed and weighted tip for guidance

Client Requirements

First Priority:

- Patient comfort during insertion
- Enable aspiration of stomach/small bowel contents
- Increase ease of insertion for the physician

Second Priority:

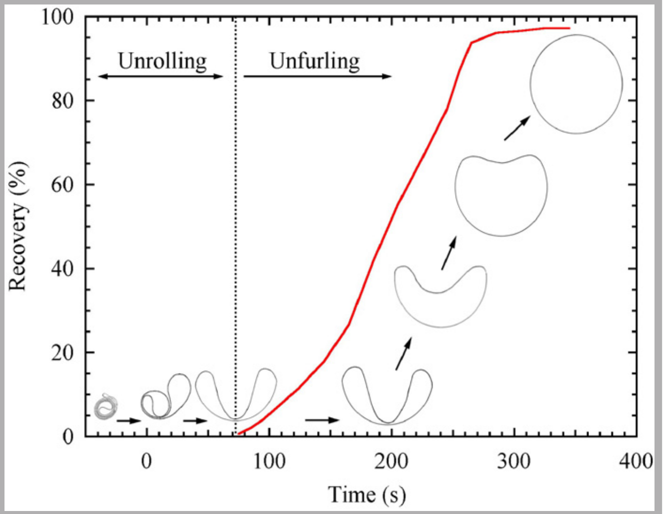
- Incorporating an anesthetic or lubricating agent
- Provide a method of confirmation of tube placement
  - X-ray
  - pH sensor
- Think Green!
  - Recyclable element incorporation

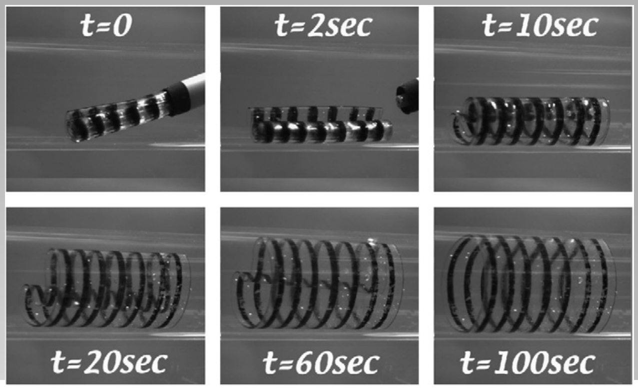
Design 1: Sleeve with folded inner tube

- Outer sleeve—small OD
- Inner sleeve—large ID
- Silicone rubber
- Pros
  - Manufacturing
  - Easily accommodates pH sensor
- Cons
  - Ease of use?
  - Material properties

Design 2: Shape Memory Polymer

- Thermoplastic polyurethane
  - Permanent shape = 6 mm OD
  - Temporary shape = 3 mm OD
  - Transition temp = 35°C
- Pros
  - Adequate expansion
  - No extra sheath
- Cons
  - Expensive
  - Advanced chemistry/ processing
  - Expansion time unknown

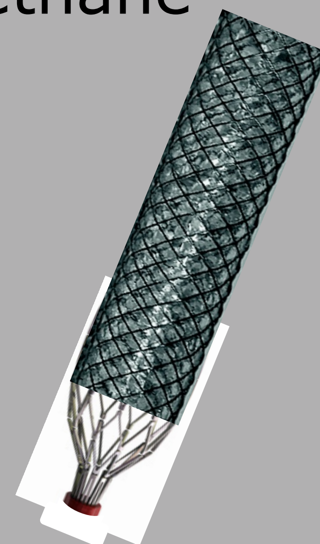


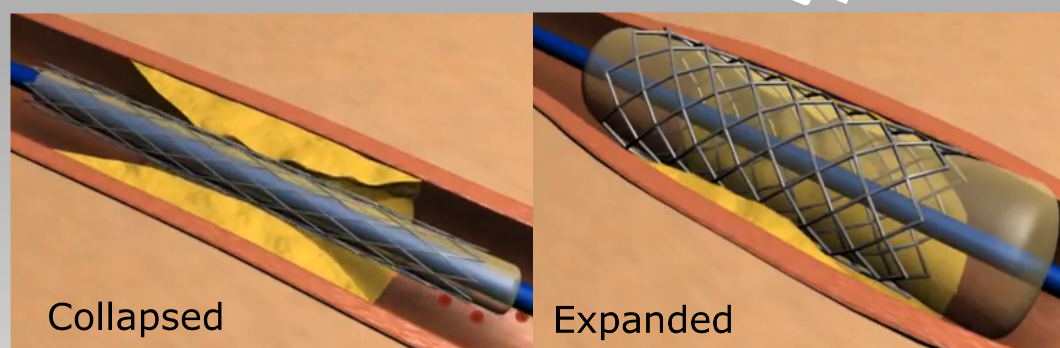


Yakacki et al. 2007

Design 3: Coated Stent

- Stainless steel wire coated with polyurethane
- Inserted in collapsed shape
- Expanded via balloon mechanism
- Pros
  - Adequate expansion
  - Resistant to collapse
- Cons
  - Expensive
  - Shortens
  - Rigidity





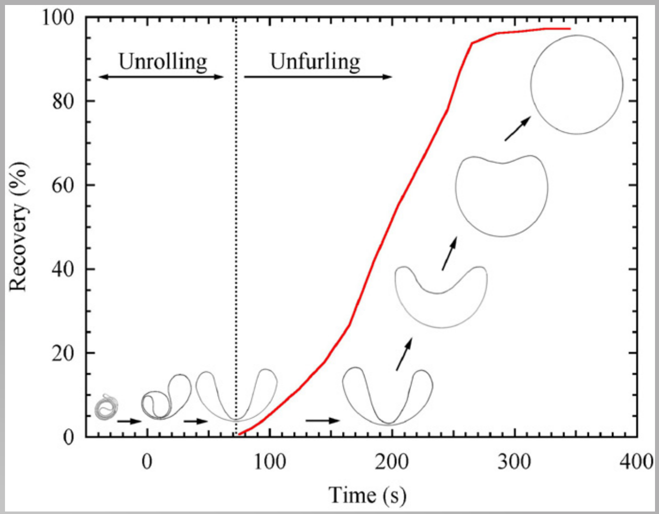
Design Matrix

Category	Weight	Shape Memory Polymer	Sleeve	Stent	Current
Cost	20	8	15	0	19
Expandability	20	16	15	19	0
Long-term Manufacturability	10	7	7	5	8
Short-term Manufacturability	10	2	6	1	8
Customizability	15	4	12	8	9
Stiffness	15	15	13	15	15
Ease of use	10	9	4	6	8
Total	100	61	72	54	67

Final Design

Future Work
This Semester

- Material of Sleeve
- Design of Interior Tube
    - Material
    - Folding pattern
        - Heart
        - Twisted octagon
        - Rolled design



Future Work
Next Semester

- Manufacturing
- Attachments to Sleeve
  - Ph monitor
  - X-ray wire
- Full Length Testing
- How to Lock inner tube into Sleeve during Insertion

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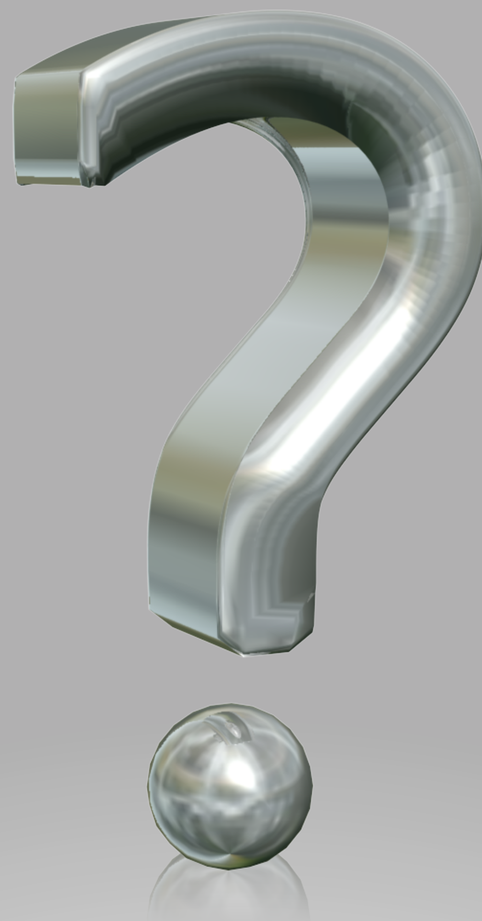
Sources

- European Respiratory Society. (2010). *Interventional Pulmonology*. Strausz, C. Bollinger, & (Eds.), *Interventional Pulmonology* (pp. 190-200).
- Huang, W., Yang, B., & Zhao, Y. (2010). Thermo-moisture responsive polyurethane shape-memory polymer and composites: a review. *Journal of Materials Chemistry*, *20*, 3367-3381.
- Lendlein, A., Behl, M., Hiebl, B., & Wischke, C. (2010). Shape-memory polymers as a technological platform for biomedical applications. *Expert Reviews*, *7*(3), 357-379.
- Opay, Mary Sue. Personal interview. 29 Sept. 2012.
- Sun, L., & Huang, W. (2010). Thermo/moisture responsive shape-memory polymer for possible surgery/operation inside living cells in future. *Materials and Design*, *31*, 2684-2689.
- Yakacki, C., Shandas, R., Lanning, C., Rech, B., Eckstein, A., & Gall, K. (2007). Unconstrained recovery characterization of shape-memory polymer networks for cardiovascular applications. *Biomaterials*, *28*(14), 2255-2263.



Questions