UW BME Design

# Reversible Contraception

Client: Professor John Webster, Ph.D.
Advisor: Professor Wan-Ju Li, Ph.D.

Design Team:
Emily Junger, Team Leader
Ngoc (Ruby) Phung, Communicator
Jolene Enge, BSAC
Yifan Li, BWIG
Zachary Katsulis, BPAG

# Overview

- Project Description
  - Problem Statement
  - Background
  - Product Design Specifications
- Design Work
  - Design Alternatives
  - Design Matrix
  - Future Work

# Problem Statement

- Need for reversible contraception
- Contraceptive pharmaceuticals cause side-effects
- Many contraceptive methods use hormones
- Surgical procedures are invasive and usually irreversible
- Opportunity for user error

# Background

- Need for product
- Relevant physiology
- Competing designs

# Need for Product

- United Nations Millennium Development Goals [1]
- Drawbacks of current methods
  - Side effects, user error
  - Interference with family planning[2]
  - Irreversibility


**Figure**: UN Millennium Development Goals

# Relevant Physiology

- Placement of valve
- Prevention of sperm passage
- Fallopian tube cross-section
- Small diameter

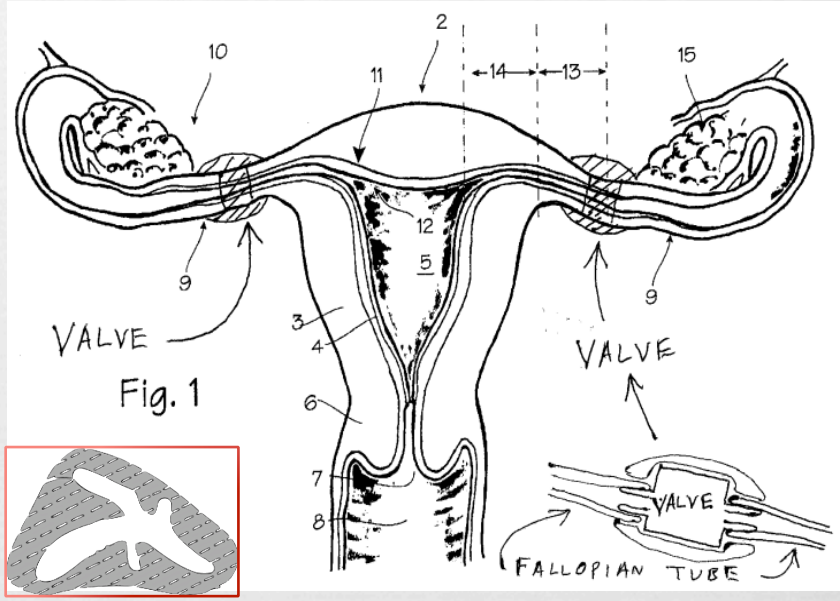



**Figure**: Valve placement and fallopian tube cross section[3]

# Competing Designs: Essure

**Figure:** Essure Insert[4]

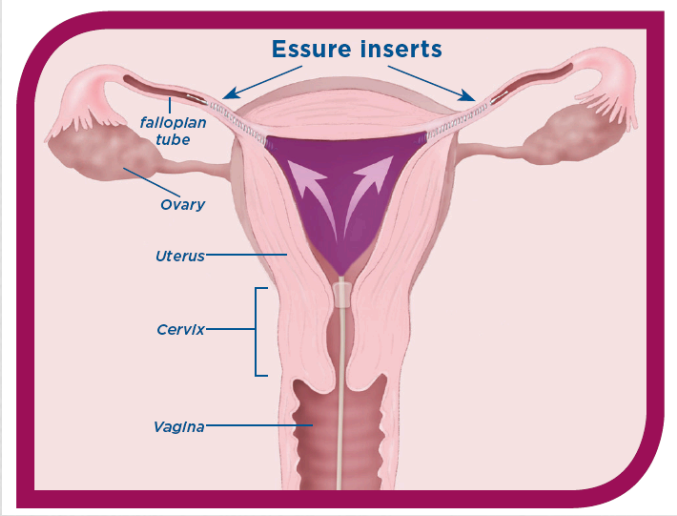



**Figure:** Essure conformation test.

- Non-surgical
- Non-hormonal
- Permanent sterilization
- Inner-outer coil construction
- Bilateral fallopian tube occlusion

# Competing Designs: ParaGuard

- Non-surgical, Nonhormonal
- Intrauterine Contraceptive Device (IUC)
- Reversible
- T-shaped construction

**Figure:** ParaGuard placement.[5]

# Product Design Specifications

- Performance Requirements:
  - Open and close at interval greater than year
  - Provide high level of contraceptive efficacy
- Materials:
  - Biocompatible, non-toxic, sterile
  - Non-ferrous
- Operating Environment:
  - Body Temperature (37°C)
- Life in Service:
  - Duration of reproductive years
- Cost:
  - $50 per unit (2 units required per individual)

# Preliminary Design Alternatives

- Iris Valve
- Leaflet Valve
- Sliding Valve
- Shape Memory Polymer Valve

# Iris Valve

- Shutter style iris valve
- Lever arm controls opening
  - Pinned, yet allows for translation

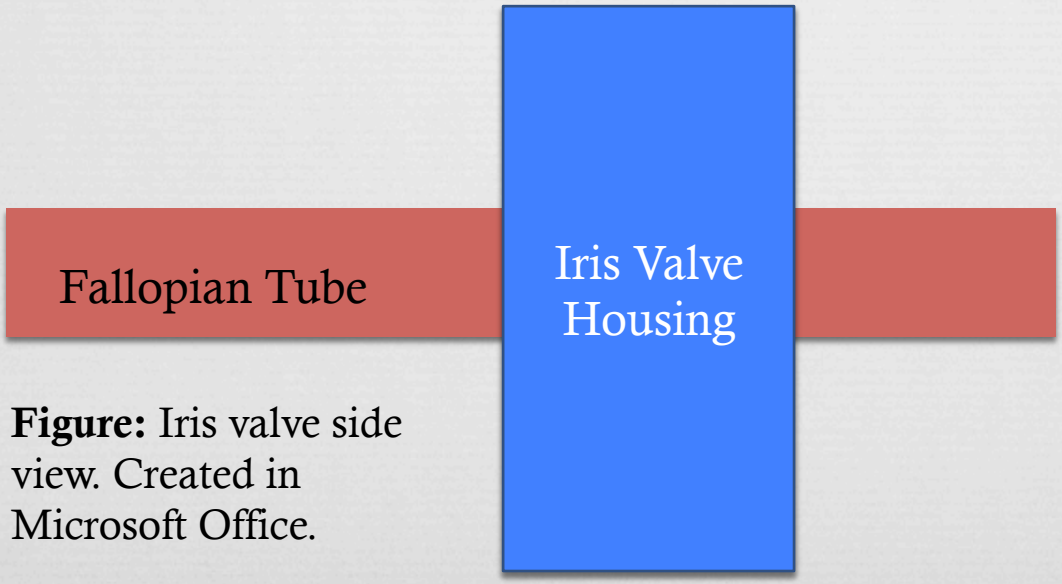



**Figure:** Iris valve side view. Created in Microsoft Office.

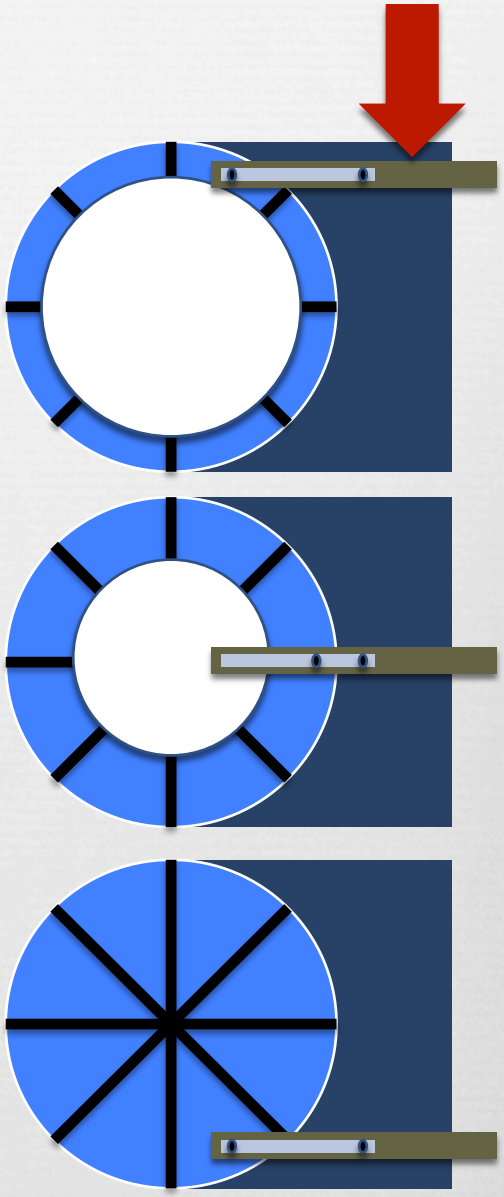
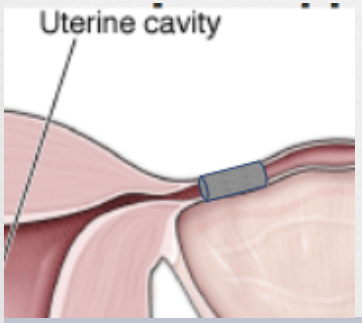
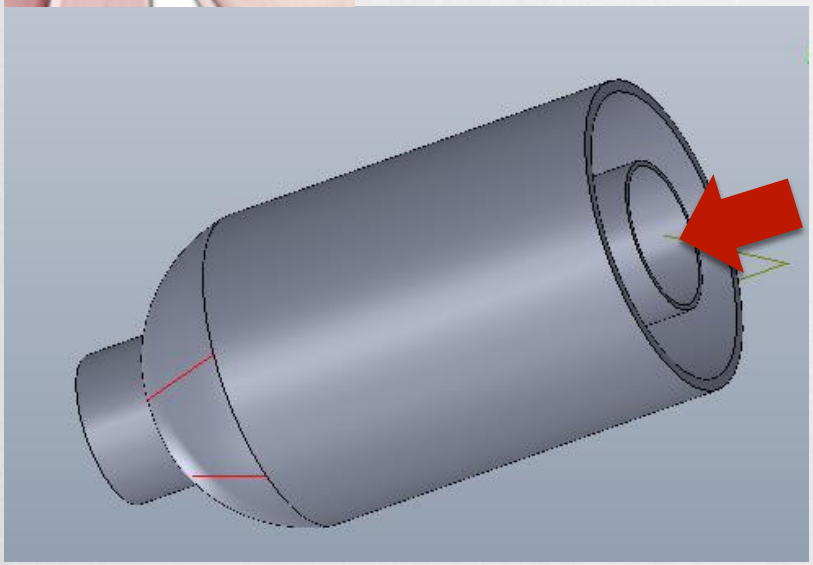


**Figure:** Iris valve cross section. Created in Microsoft Office.

# Leaflet Valve



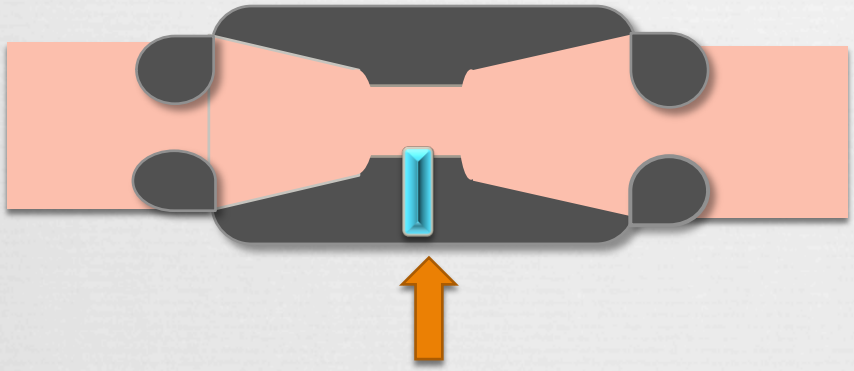



- Two nested cylinders
- Sliding action induced by electromagnetic force
- Leaflets under tension
- Biocompatible polymer

**Figure:** Leaflet valve and placement.[6] Created in Solidworks.

# Sliding Valve

Side view



Transverse Cross-Section view

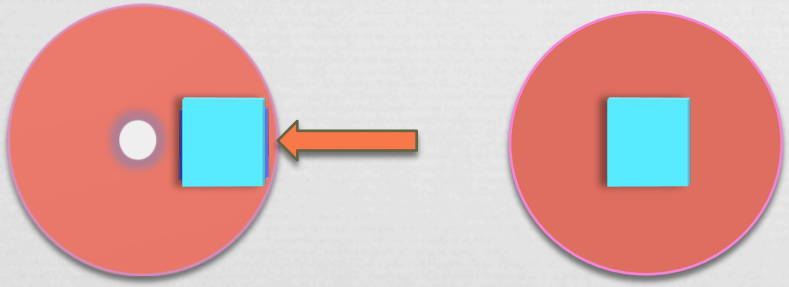
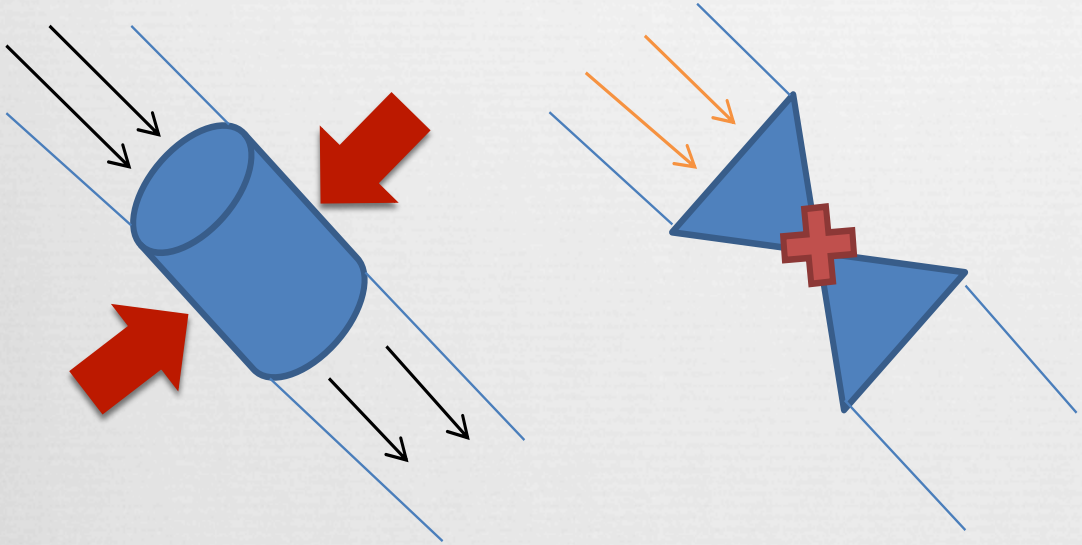


**Figure:** Created in Microsoft Office

- Funnel guidance
- Sliding plate embedded in housing
- Uniaxial force applied via external controller

# Shape Memory Polymer Valve



Shape One: free passage through tube

Shape Two: no passage through tube

- Shape conformation induced by magnetic field
- Feasibility and reliability issues

**Figure:** Shape memory polymer valve.
Created in Microsoft Office

# Design Matrix

| Parameters | Weight | Leaflet Valve | Sliding Valve | Iris Valve | Shape Memory Polymer Valve |
|---|---|---|---|---|---|
| Purchase Cost | 10 | 6 | 10 | 10 | 6 |
| Contraceptive Effectiveness | 35 | 28 | 28 | 28 | 21 |
| Biocompatibility/ Safety | 35 | 28 | 21 | 21 | 28 |
| Reliability | 10 | 4 | 8 | 6 | 6 |
| Feasibility of Fabrication | 10 | 4 | 8 | 6 | 6 |
| **Total** | 100 | 70 | **75** | 71 | 67 |

# Summary

| Parameters | Weight | Sliding Valve |
|---|---|---|
| Purchase Cost | 10 | 10 |
| Contraceptive Effectiveness | 35 | 28 |
| Biocompatibility/ Safety | 35 | 21 |
| Reliability | 10 | 8 |
| Feasibility of Fabrication | 10 | 8 |
| **Total** | 100 | **75** |

- Highest relative score
- Validity of design

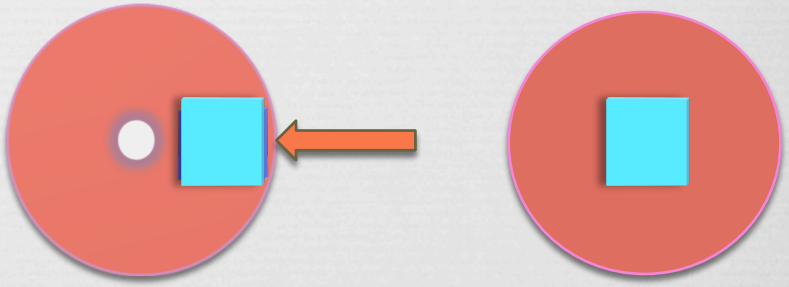


**Figure:** Sliding valve. Created in Microsoft Office

# Future Work

- Further improvement of design
- Selection of material
- Prototype fabrication
- Testing
- Develop external controller

Projected Timeline

| Tasks | Oct | | | | Nov | | | | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 7 | 14 | 21 | 28 | 4 | 11 | 18 | 25 | 2 | 9 |
| **Project Development** | | | | | | | | | | |
| Final Design | | | | | | | | | | |
| Order Materials | | | | | | | | | | |
| Fabrication | | | | | | | | | | |
| Testing | | | | | | | | | | |

# References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# Acknowledgments


- Professor Webster
- Professor Li
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# Questions?