FLOS NC

TRANSFORMING WOMEN'S HEALTH DIAGNOSTICS - ONE CUP AT A TIME

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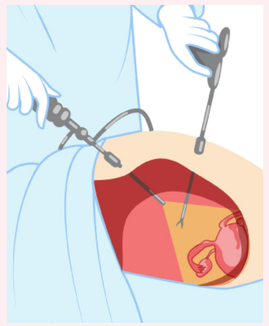
The Diagnostic Gap



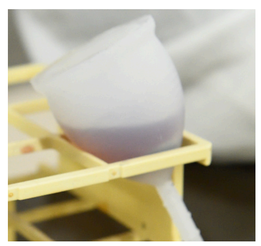
Current diagnostic pathways for reproductive health conditions are **invasive** and lead to **unacceptable delays:**

- Endometriosis: Average **10-year** diagnostic delay
- PCOS: **70%** of cases remain undiagnosed worldwide
- Adenomyosis: **1 in 3 women** are asymptomatic and require invasive procedures for diagnosis
- Ovarian Cancer: **54%** mortality rate due to delayed detection

Despite menstrual fluid containing 930 proteins (385 unique) that drive inflammation, hormone signaling, and immune response pathways—critical biomarkers remain uncollected and unstudied.

Proof of Concept and Initial Prototype

- **Successful fabrication of cup** with integrated collection chamber using precision CAD models and silicone molding
- **Effective filtration** of synthetic menstrual fluid analog with clots modeled by Jello and mucous strands modeled using slime
- **Stable sample collection** via vacutainer system (1.0-2.5 mL yield) without filter unit collapse



Testing with artificial blood at the vaginal angle

Blood passes through the filter

A picture of the sample being collected after filtration

Our Solution: Integrated Sample Filtration and Collection

User-Centered Design

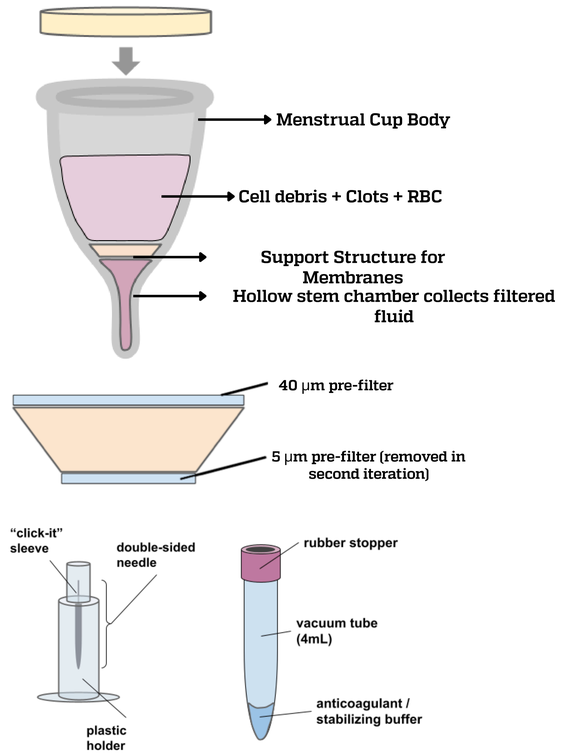
Prototype mimics a standard menstrual cup which integrates seamlessly into daily use enabling **non-invasive biomarker detection** during regular menstruation. "Click-it" vacutainer system enables **easy sample extraction.**

Sample Integrity

Layer-by-Layer coating technology with protease inhibitors, RNase inhibitors, and EDTA **stabilizes critical protein and genetic markers**

Research Revolution

Solves the recruitment bottleneck in women's health research by enabling **standardized, high-compliance sample collection at scale**—eliminating unpredictable timing issues that plague current studies



Engineering Analysis and Flow Modeling

Governing Model: Darcy's Law

$$Q = \frac{\Delta P}{\mu\left(\frac{L1}{K1A1} + \frac{L2}{K2A2}\right)}$$

Assumptions: Laminar, steady-state flow; Newtonian fluid; homogeneous membrane

Corrections: Adjust for non-Newtonian behavior, variable viscosity, and pressure drop using experimental data and empirical model validation

Features	Values
Pre-filter	40 μm
Final Filter	5 μm
Permeabilities	$1e^{-10}$,$1e^{-12}$
Passive Flow (mL/min)	0.282
Fouled Yield (6h)	~ 6.4 mL

Hydrostatic Driving Force

Assuming vaginal insertion angle of 35°:

H = 3 cm × sin (35°) = 0.0172 m
ΔP = ρgH = 1060 × 9.81 × 0.0172 = **179 Pa**

Modeling Fouling and Cake Formation: Hermia's Cake Growth Model

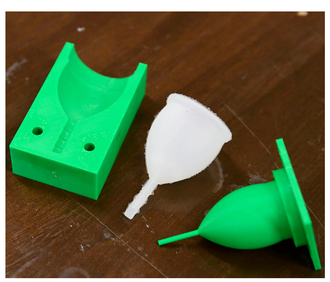
$$\frac{1}{Qt} = \frac{1}{Q0} + \alpha t$$

Assumptions: Uniform cake formation; time-dependent fouling; Fouling constant (α) not derived from menstrual fluid data.

Corrections: conduct time-resolved filtration experiments using menstrual fluid analogs across membranes. Measure flow rate decline and fit to Hermia's model to empirically derive α under both passive and vacuum-assisted conditions.

Learnings From Prototype 1

- No flow observed through 5μm filter
- Pre-wetting essential to initiate flow
- Cross-shaped debris trap restricts folding for insertion



Design Changes

- **Removing 5uM** filter to address flow restriction and sample insufficiency while maintaining sample quality
- **Mesh-based debris trap** using 600uM silicone mesh instead of cross for robust clot-catching and folding maintenance
- **Alternative Filter Materials** such as hydrophilic nylon, cellulose acetate, and glass fiber for improved flow and filtration without the need for pre-wetting

Pathway to Impact

- Animal blood testing
- *Ex-vivo* menstrual blood testing
- *In-vivo* menstrual blood and biocompatibility testing
- MVP finalization
- Research partnerships for biomarker discovery and validation

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