Fluid Injection Management System

Team Members

Chris Besaw (Team Leader), Steve Young (Communicator), Rafi Sufi (BSAC), John Diaz de Leon (BWIG)

Advisor

Dr. Naomi Chesler

Client

Dr. Charles Strother

Overview

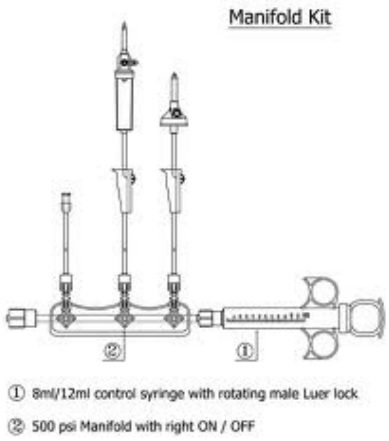
- Client Description
- Current Devices
- Problem Motivation
- Design Requirements
- Design Alternatives
- Design Matrix
- Future Work
- Acknowledgements

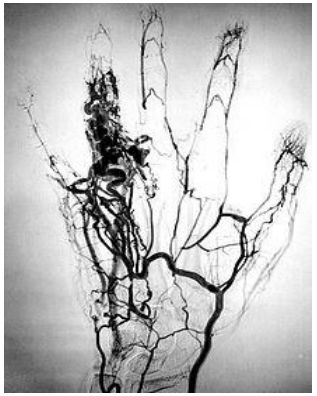
Client Description

- Dr. Charles Strother
  - Department of Radiology
  - Angiography Research

Angiography

- Visualization of Blood Vessels
- Imaging Technologies
  - X-ray Radiation Exposure
- Contrast Agents
- Power Injection vs. Hand Injection



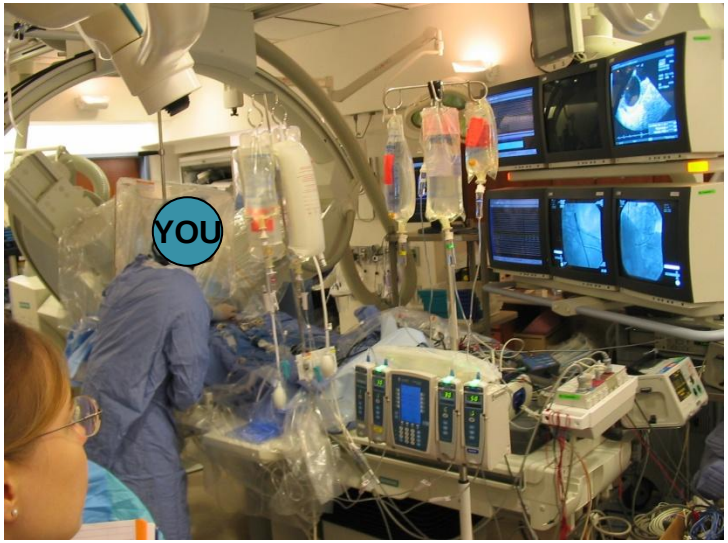


Current Devices/Designs

- Medrad Avanta Fluid Management Injection System
- Manifold
  - Integrating System
- Saline Dispensing

Problem Motivation

- Inefficient workspace
- Air bubble
- Blood contamination
- Extended x-ray exposure
- Constant need for saline
- Hard to monitor reservoir levels



Design Requirements - Manifold

- Streamline angiographic process
- Compatible with power injector
- Blood and air bubble detection
- Saline rinse and waste removal
- Disposable

Design Requirements – Manifold Stand

- Should not obstruct manifold operation
- Maintain manifold visibility
- Compact
- Flexible positioning

Design Requirements – Saline Source

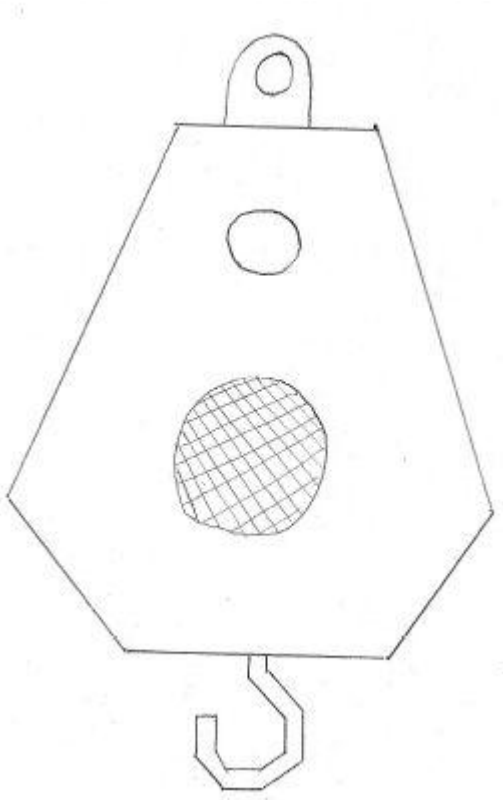
- Indicate when bag is empty
- Sterile
- Detect and prevent air bubbles
- Simple to use

Design Alternative: Peristaltic Pump

- Pumps at constant rate
  - Regardless of saline level
- Hooks up directly to manifold
- Positioned on work space near manifold

Design Alternative: Hanging Alarm

- Scale attached to hanging saline bag
- Alarm or light goes off at specific weight
  - Bag weight calculated when saline solution empty



Design Alternatives: Floating Ball

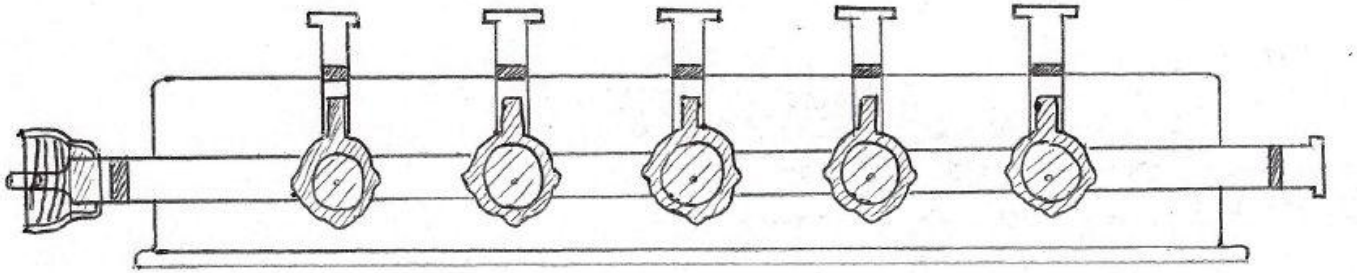
- Floating ball in flexible chamber below bag
- Stops flow when saline level approaches zero
- Must be sterile

Design Matrix: Saline Flush

	Peristaltic Pump	Hanging Alarm	Ball Stopper
Consistency (20)	20	16	16
Cost (5)	2	3	4
Space Efficiency (15)	10	14	15
Safety (20)	15	17	18
Ease of Manufacturing (15)	15	8	13
Fluid Level Detection (25)	24	19	22
Total (100)	86	77	88

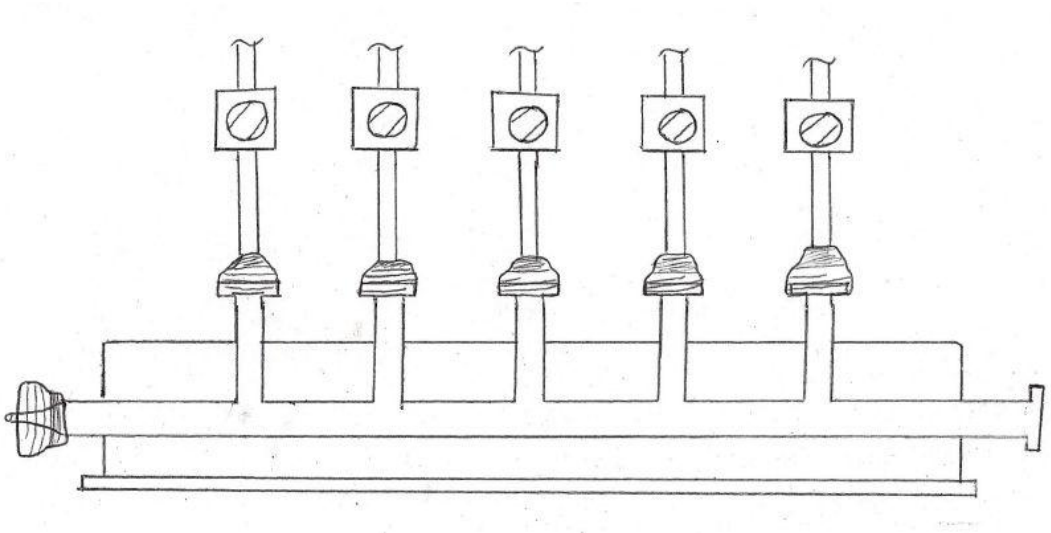
Design Alternatives – Single Piece Manifold

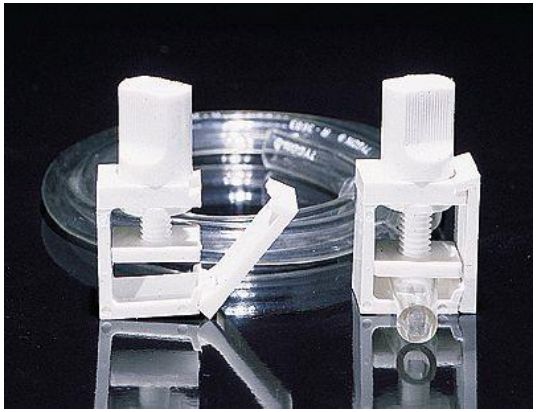
- Based on typical manifold
- Built in one way valves
- Shortened stopcock handle



Design Alternative: Screw Clamp

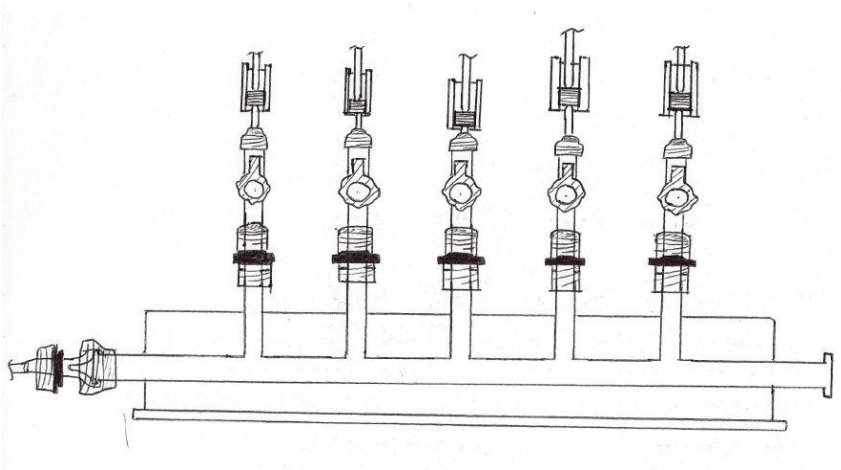
- Screw clamps attach to tubes upstream of manifold
- Manifold does not have stopcocks integrated into design





Design Alternative – Multiple Piece Manifold

- Base piece: Manifold Shell
- Components attached upstream of ports
  - Two-way stopcocks
  - One-way luer lock valves
  - Adjustable rolling tube clamps

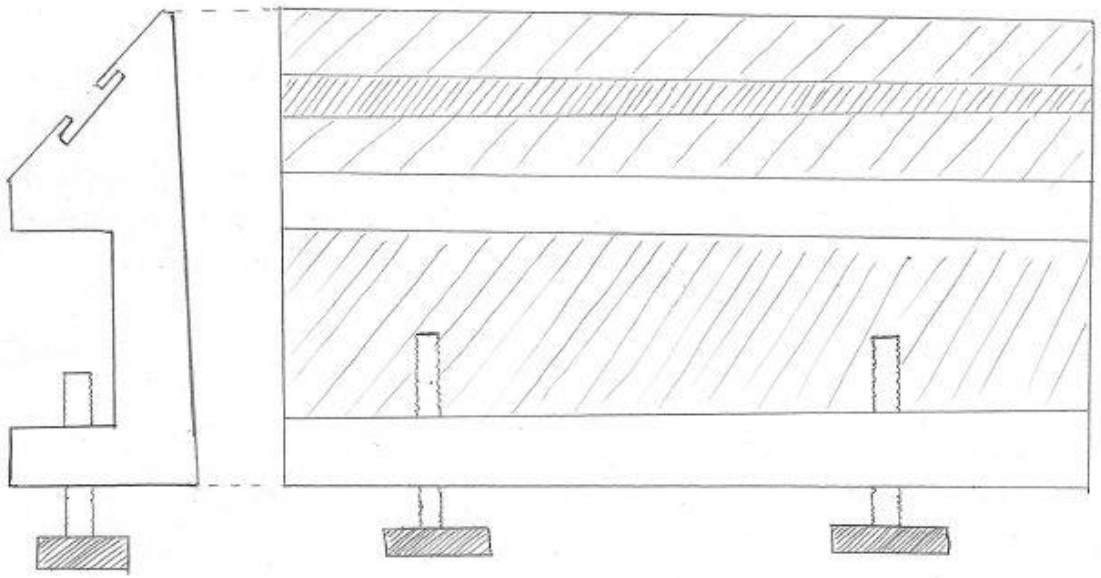


Design Matrix: Manifold

	‘Single piece' Design	‘Multiple pieces' Design	Tubing Clamps
Ease of Manufacturing (25)	15	20	24
Cost (5)	4	4	5
Contamination Detection (15)	10	12	14
Fluid Control (30)	24	29	18
Set-up Time (25)	20	16	18
Total (100)	73	81	79

Manifold Holding Design: Clamp

- Manifold clamped to table
- Clamp moveable to various positions
- Manifold hangs over table



Future Work

- Observe procedure
- Interview professionals
- Order necessary materials
- Assemble/fabricate designs
- Identify testing methods
- Test initial set-up vs. final set-up

Acknowledgements

- Dr. Charles Strother
- Dr. Naomi Chesler
- Dr. Tom Yen

References

- Radiological Society of North America, Inc. 2011. Catheter Angiography [Online] http://radiologyinfo.org/en/info.cfm?pg=angiocath.
- Radiological Society of North America, Inc. 2011. CT Angiography (CTA) [Online] http://radiologyinfo.org/en/info.cfm?pg=angioct.
- Radiological Society of North America, Inc. 2011. MR Angiography (MRA) [Online] http://radiologyinfo.org/en/info.cfm?pg=angiomr.
- Radiological Society of North America, Inc. 2011. Contrast Material [Online] http://radiologyinfo.org/en/glossary/glossary1.cfm?gid=80.
- MEDRAD, Inc. 2010. What is Power Injection? [Online] http://www.medrad.com/en-us/resources/KnowledgeCenter/Pages/WhatisPowerInjection.aspx.