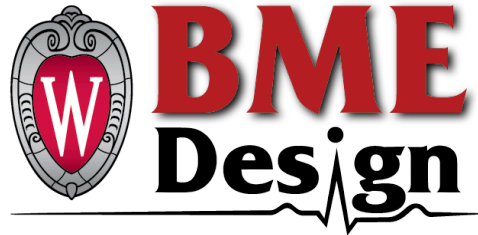


Progress Report: March 22nd - April 4th



**Computed Tomography (CT) Circulation
Phantom to Assess Hyperdynamic Contrast
Flow Rates**

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Team:

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Problem statement

A CT phantom is a device used to calibrate Computed Tomography machines by acting as a “stand in” for human tissues [1]. Most phantoms currently in use are static; they do not allow for dynamic flow. Some patients obtaining a CT scan may need a circulatory support device, such as a VA-ECMO (veno-arterial extracorporeal membrane oxygenation) [2] device. There is a clinical need for a CT phantom with dynamic flow capabilities to study the correct ways to conduct CT vascular imaging for patients on ECMO devices. This phantom should model the inflow and outflow of an ECMO patient and have capabilities to simulate the addition of contrast media into the vascular system. Ultimately, this device will help medical personnel to better understand the flow of CT contrast through a patient on an ECMO machine, as the circulation flow rate of an ECMO patient differs from a patient not on ECMO.

Brief status update

The team is still working on finding the right pump for the system and was provided a few options by the BME teaching lab. Currently, the centrifugal pump is the choice to be tested and the team is working on finding an air compressor to work it. The team is also in the prototyping phase. An overall circuit design was roughly decided on, including a 6L fluid reservoir to mimic the total blood in the body. Connectors for the tubing and pump will be purchased and 3D modeling of an initial draft is being worked on to be printed next week. The team also met with CT technicians at UW hospital to better understand the procedures we are working to mimic. The team will take these scans and compare the MROI plots to those of our system.

Difficulties / advice requests

Previous design

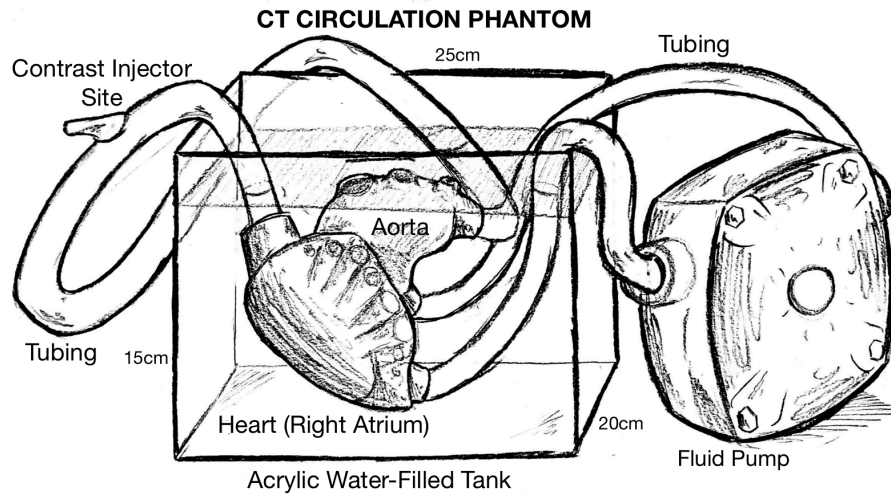


Figure 1: Final design sketch.

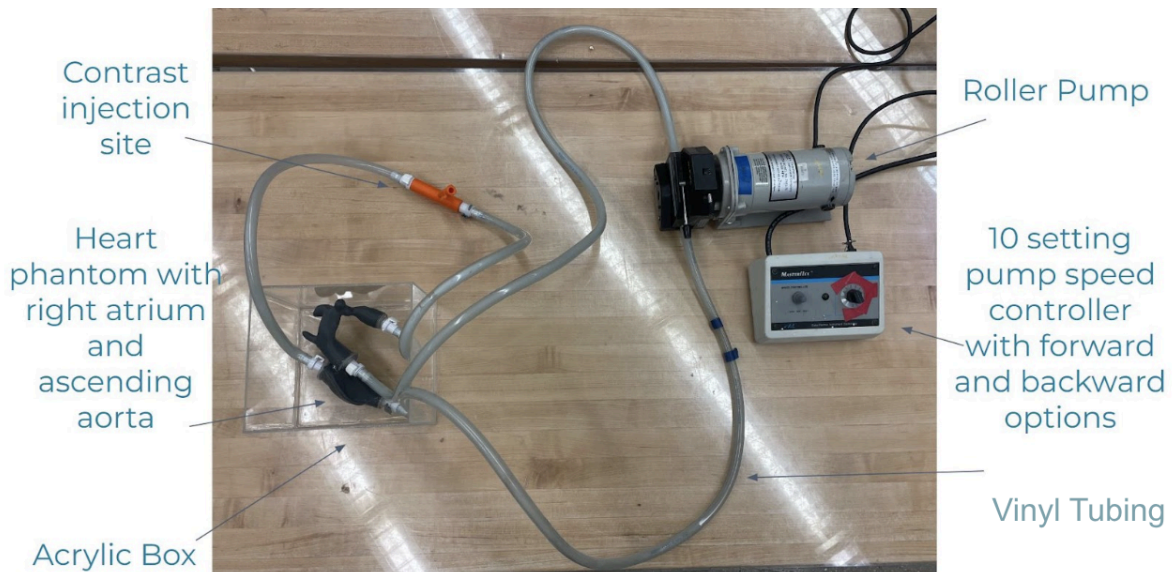


Figure 2: Final fabricated circulation phantom prototype with acrylic box, heart phantom, injection site, roller pump, speed controller, tubing, and connectors

Current Design

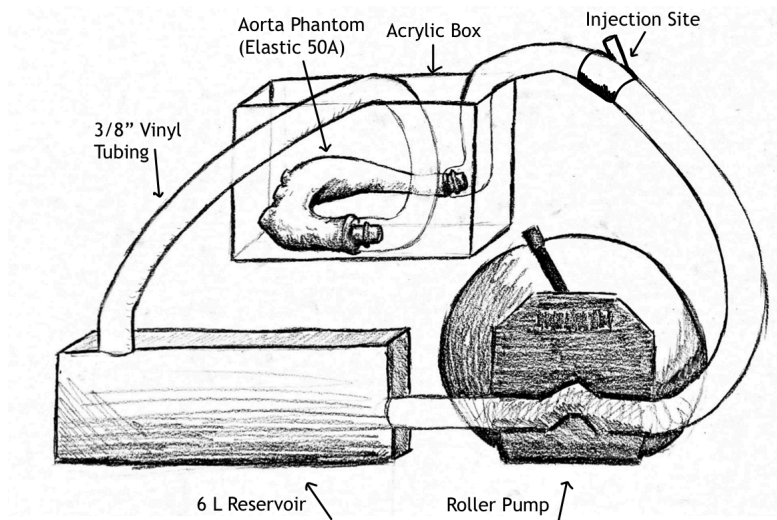


Figure 3: Current circulation phantom design including large reservoir, roller pump with flow capabilities up to 8 L/min, injection site, and aortic arch phantom

Materials and expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1- Materials										
Elastic 50A Resin	Elastic used for printing connector 3D print 5.41 mL	FormLabs	RS-F 2-EL CL-0 2	UW Makers pace	Elastic	2/28/2 024	1	1.63	\$1.63	Makerspace
Elastic 50A Resin	Elastic used for printing the aorta and connectors 44 mL	FormLabs	RS-F 2-EL CL-0 2	UW Makers pace	Elastic	3/20/2 024	1	12.84	\$12.84	Makerspace
Category 2										
Tubing adapter	Connector to join together 3/8 inch tubing to 1/2 inch tubing into the pump	Green Leaf	CBA 3812 BG1	ACE Hardwa re	48762	3/13/2 024	2	2.79	\$5.58	ACE Hardware
									\$0.00	
								TOTAL	\$20.05	

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Major team goals for the next week

1. Begin fabricating the phantom
2. Begin testing on the pump
3. Begin fabricating the circuit

Next week's individual goals

- Lucy O'Cull
 - Assist with aorta fabrication and post print clean up
 - Connect the phantom, tubing, and pump
- Emma Flemmer
 - Test and calibrate the pump to produce desired flow rates
 - Contact CT techs to schedule a scan time
- Sophie Speece
 - Redesign the aorta to be larger. Keep the connectors the same size
 - Experiment with connecting the aorta sections (silicone, melting, chemical bonding)
- Lizzie Maly
 - Assist with aorta redesign and reprint
 - Purchase supplies including tubing and connectors to add to our project.
- Shriya Kaushik
 - Help with fabricating the aorta
 - Go to the store and purchase piping and exchange connectors

Timeline

Task	Jan	Feb				March					April				May	
	26	2	9	16	23	1	8	15	22	29	5	12	19	26	3	10
Project R&D																
Empathize																
Background...	X	X														
Prototyping																
Testings																
Deliverables																
Progress Reports	X	X	X	X	X	X	X	X	X	X	X					
Prelim presentation					X											
Final Poster																
Meetings																
Client			X													
Advisor	X	X	X	X	X	X										
Website																
Update	X	X	X	X	X	X	X									

Filled boxes = projected timeline

X = task was worked on or completed

Previous week's goals and accomplishments

- Lucy O'Cull
 - Attended team meeting to plan fabrication
 - Cleaned up 3D print of the aorta
 - Wrote call to action for senior BME design help with connecting existing Luer Lock Cannulation
- Emma Flemmer
 - Attended team meeting to plan fabrication
 - Cleaned up 3D print of the aorta
 - Wrote call to action
- Sophie Speece
 - Printed the aorta phantom
- Lizzie Maly
 - Presented at show and tell to get ideas from older students on how to improve our project
 - Planned fabrication of the aorta
 - Assisted with fabrication of the 3D print of the aorta
- Shriya Kaushik

- Attended team meeting to plan fabrication
- Cleaned up 3D print of the aorta
- Wrote call to action

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Lizzie Maly	01/31/2024	Literature Research	2	2	2
Shriya Kaushik	01/31/2024	Background and literature research	2	2	2
Sophie Speece	01/31/2024	Literature research	2	2	2
Lucy O’Cull	01/31/2024	Literature research	2	2	2
Emma Flemmer	02/01/2024	Literature research	2	2	2
Sophie Speece	02/02/2024	Literature research on VA-ECMO background information	2	2	2
Lucy O’Cull	02/05/2024	Group meeting planning and review PDS for delegation	0.5	0.5	2.5
Lucy O’Cull	02/08/2024	Contribution to PDS	1	1.5	4
Emma Flemmer	02/05/2024	Communication with client and advisor	0.5	0.5	2.5
Emma Flemmer	02/08/2024	Research and writing for the PDS	1.5	2	4
Sophie Speece	02/08/2024	Literature research focused on existing designs	2	2	4
Lizzie Maly	02/08/2024	Literature Research	1.5	2	4
Lizzie Maly	02/08/2024	Contribution to PDS	.5	2	4
Shriya Kaushik	02/08/2024	PDS sections	0.5	0.5	2.5
Shriya Kaushik	02/08/2024	Researching and reading old reports	1.5	1.5	4
Lucy O’Cull	02/12/2024	Worked on abstract	0.5	0.5	4.5
Lucy O’Cull	02/13/2024	Group design matrix discussion	1	1.5	6

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Lucy O'Cull	02/15/2024	Literature research	1	2.5	7
Emma Flemmer	02/13/2024	Contributed to abstract	0.5	0.5	4.5
Emma Flemmer	02/14/2024	Team meeting to discuss designs	1	1.5	5.5
Emma Flemmer	02/15/2024	Materials research	1.5	3	7
Sophie Speece	02/14/2024	Met with team and researched potential 3D printing materials	2.5	2.5	6.5
Lizzie Maly	2/14/2024	Team Meeting to Discuss	1	2	5
Lizzie Maly	2/14/2024	Pump Research and Material Research	1	2	6
Shriya Kaushik	2/14/2024	team meeting	1	1	5
Shriya Kaushik	2/14/2024	Researched pumps and materials	2	2	7
Lucy O'Cull	2/22/2023	Researched mathematical modeling	2	2	9
Emma Flemmer	2/21/2024	Worked on preliminary presentation	1	1	8
Emma Flemmer	2/20/2024	Communicated with client resources to arrange meeting times	0.5	1.5	8.5
Sophie Speece	2/22/24	Acquired heart and aorta 3D files online and began to augment them in Meshlab, Meshmixer and Blender to fit project needs	1	1	7.5
Shriya Kaushik	2/22/24	Worked on prelim presentation, continued research	1	1	8
Lizzie Maly	2/21/24	Worked on prelim presentation	1	1	7
Lizzie Maly	2/22/24	Research material options for design matrix	1	2	8
Sophie Speece	2/23/24	3D modeled two different connection designs so that the aorta can more seamlessly connect to the tubing and prevent leaks	1	1	8.5
Sophie Speece	2/24/24	Smoothed aortic arch and root model, then began attaching aforementioned connections	2	3	10.5
Sophie Speece	2/27/24	Sketched out Final Design	0.5	3.5	11
Sophie Speece	2/28/24	Worked on writing and editing slides of the preliminary presentation	1	4.5	12
Emma Flemmer	2/28/2024	Work on the preliminary presentation	1	1	9.5
Shriya Kaushik	2/28/2024	Work on the preliminary presentation	1	1	9

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Lizzie Maly	2/28/2024	Worked on preliminary presentation	1	1	9
Lucy O'Cull	2/28/2024	Worked on preliminary presentation	0.5	0.5	9.5
Emma Flemmer	3/5/2024	Pump meeting	0.5	0.5	10
Emma Flemmer	3/6/2024	Worked on preliminary report	1	1.5	11
Lucy O'Cull	3/5/2024	Pump meeting	0.5	0.5	10
Lizzie Maly	3/6/2024	Worked on preliminary report	1	1	10
Lizzie Maly	3/6/2024	Met to evaluate pumps	.5	1.5	10.5
Sophie Speece	3/7/2024	Worked on preliminary report	0.5	0.5	12.5
Shriya Kaushik	3/6/2024	Worked on preliminary report	1	1	10
Lucy O'Cull	3/7/2024	Worked on preliminary report	1	1.5	11
Emma Flemmer	3/12/2024	Meeting with CT techs at WIMR	1	1	12
Lucy O'Cull	3/12/2024	Meeting with CT techs at WIMR	1	1	12
Sophie Speece	3/12/2024	Zoom meeting with CT techs	1	1	13.5
Lizzie Maly	3/13/2024	Discussed fabrication and circuit with team	.5	.5	11
Lucy O'Cull	3/13/2024	Discussed fabrication and circuit with team	0.5	0.5	12.5
Emma Flemmer	3/13/2024	Picked up materials from ACE Hardware and WIMR	1	2	13
Emma Flemmer	3/13/2024	Discussed fabrication and circuit with team	0.5	2.5	13.5
Sophie Speece	3/13/2024	Discussed fabrication and circuit with team	0.5	0.5	14
Shriya Kaushik	3/13/2024	Discussed circuit schematics with team	0.5	0.5	11
Emma Flemmer	3/19/2024	Brainstormed circuit design	0.5	0.5	13.5
Shriya Kaushik	3/18/2024	Met with team and advisor to assemble circuit	0.5	0.5	11.5
Sophie Speece	3/19/2024	Aorta and connectors 3D modeling, wrote portions of aorta fabrication protocol	4	4	18
Lizzie Maly	3/12/2024	Met with CT Techs at WIMR	1	1	11.5
Lizzie Maly	3/18/2024	Met with team and advisor to assemble circuit	.5	1.5	12
Lizzie Maly	3/19/2024	Worked on connector SolidWorks to add to 3D	1	2.5	13

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
		model			
Emma Flemmer	4/3/2024	Team meeting and print cleanup	1.5	1.5	15
Lucy O’Cull	4/3/2024	Team meeting and print cleanup	1.5	1.5	14
Lucy O’Cull	4/3/2024	Call to action write up	0.5	2	14.5
Lizzie Maly	4/3/2024	Team Meeting and print cleanup	1.5	1.5	14.5
Shriya Kaushik	4/3/2024	Print cleanup and team meeting	1.5	1.5	13