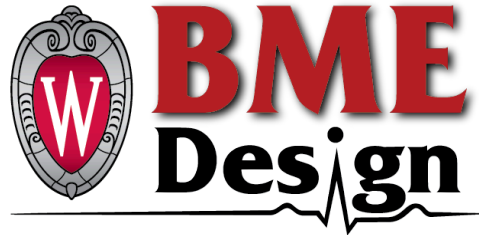


Progress Report: April 12th - April 18th, 2024



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

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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

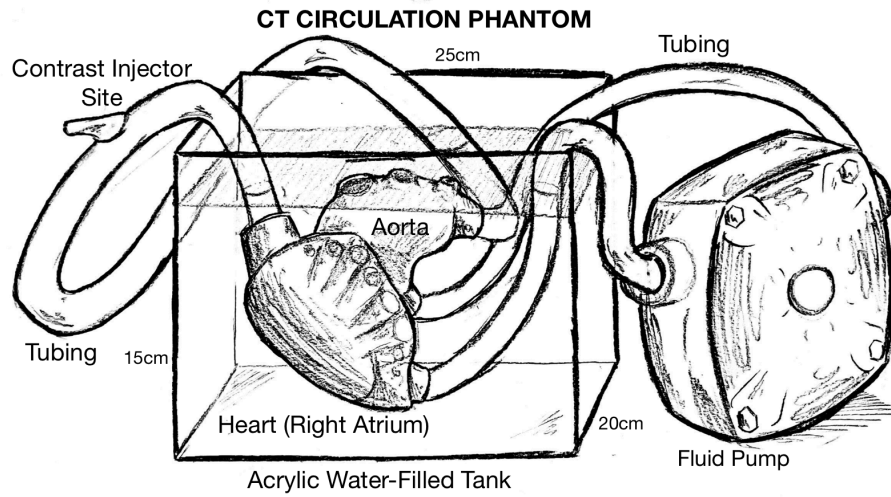


Figure 1: Final design sketch.

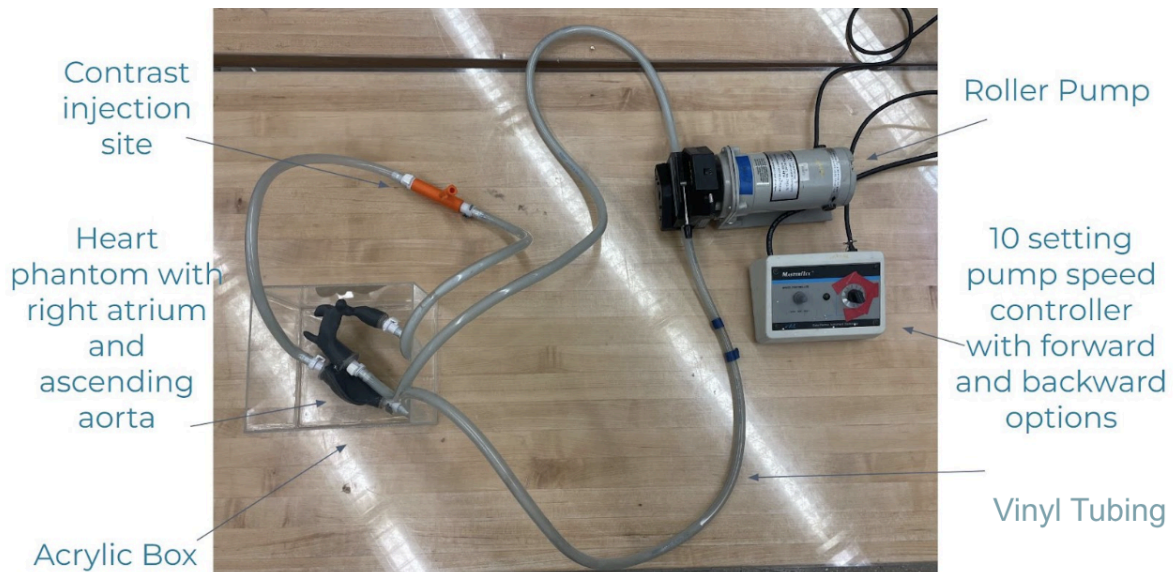


Figure 2: Final fabricated circulation phantom prototype with acrylic box, heart phantom, injection site, roller pump, speed controller, tubing, and connectors

Current Design

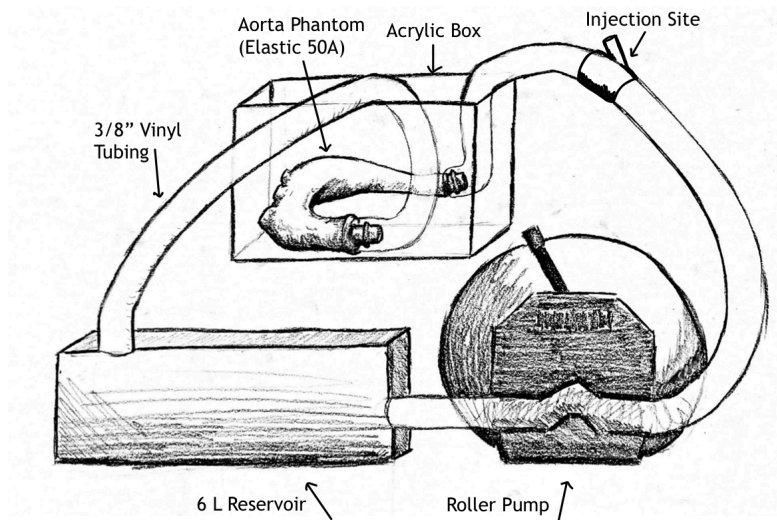


Figure 3: Current circulation phantom design including large reservoir, roller pump with flow capabilities up to 8 L/min, injection site, and aortic arch phantom

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 Makerspace	Elastic	2/28/2024	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 Makerspace	Elastic	3/20/2024	1	12.84	\$12.84	Makerspace
Elastic 50A Resin	Elastic used for reprinting the aorta (larger size) 161.44 mL	FormLabs	RS-F 2-EL CL-0 2	UW Makerspace	Elastic	4/9/2024	1	46.82	\$46.82	Makerspace
Category 2										
Tubing adapter	Connector to join together 3/8 inch	Green Leaf	CBA 3812	ACE Hardware	48762	3/13/2024	2	2.79	\$5.58	ACE Hardware

	tubing to ½ inch tubing into the pump		BG1	re						
Tubing adapter	Connector to join tubing with flipped dimensions (3/8 in x ½ in)	Green Leaf	CBA 1238 BG1	ACE Hardware	48764	4/6/2024	2	2.79	\$5.89	ACE Hardware
PVC Vinyl Tubing	Tubing used to connect the printed aorta and pump	ACE Proline	CP01 2038 010H	ACE Hardware	4315552	4/3/24	1	9.48	\$9.48	ACE Hardware
								TOTAL	\$82.24	

Major team goals for the next week

1. Complete testing
2. Scan the device on a CT scanner

Next week's individual goals

- Lucy O'Cull
 - Attend CT scan session
 - Do statistical analysis of testing
 - Prepare for the final presentation
- Emma Flemmer
 - Attend CT scan session
 - Do statistical analysis of testing
 - Prepare for the final presentation
- Sophie Speece
 - Attend CT scan session
 - Do statistical analysis of CT testing
 - Complete assigned sections of poster
- Lizzie Maly
 - Attend CT scan session
 - Do statistical analysis of CT testing
 - Complete poster and prepare for final presentation
- Shriya Kaushik
 - Start working on final poster
 - Go to WIMR to complete CT testing and analysis

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						X	X	X	X		X					
Testings																
Deliverables																
Progress Reports	X	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	X	X	X		X	X				
Website																
Update	X	X	X	X	X	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
 - Planned out/assembled the tubing for the phantom
 - Began work on the poster deliverable
- Emma Flemmer
 - Scheduled CT time for the team
 - Incorporated injection site into the circuit
 - Assembled the phantom
- Sophie Speece
 - Design pipe fitters for separately printed 3D aorta to join them together
 - Printed the connectors
- Lizzie Maly
 - Retrieved compressor to power our pump
 - Tested adhesive options for aorta on model aorta
 - Planned phantom assembly
- Shriya Kaushik
 - Met with team to assess circuit logistics
 - Assembled parts of the aorta

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
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

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
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
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

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
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 model	1	2.5	13
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

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
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
Lucy O’Cull	4/6/2024	ACE tubing and adapter procurement, initial fit testing	1	1	15.5
Sophie Speece	4/9/2024	Aorta remodeling	1.0	1.0	19
Emma Flemmer	4/10/2024	Team meeting and pump testing	1	1	16
Lizzie Maly	4/10/2024	Team meeting and pump testing	1	1	15.5
Sophie Speece	4/10/2024	Team meeting and pump testing	1.0	2.0	20
Emma Flemmer	4/11/2023	Executive summary work	0.5	1.5	16.5
Shriya Kaushik	4/10/2023	Executive summary	0.5	0.5	13.5
Shriya Kaushik	4/10/2023	Team meeting and pump testing	1	1.5	14.5
Lucy O’Cull	4/10/2023	Team meeting and pump testing	0.5	1.5	16
Lucy O’Cull	4/11/2024	Executive summary work & print post-processing	0.5	2	16.5
Sophie Speece	4/16/2024	Design and print “pipe fitters” for the aorta	0.5	0.5	20.5
Emma Flemmer	4/15	Scheduling CT time	0.5	0.5	17
Emma Flemmer	4/17	Team fabrication and flow rate testing meeting	1	1.5	18
Emma Flemmer	4/17	Worked on poster	0.5	2	18.5
Lizzie Maly	4/17	Prepared spreadsheet for testing and worked with team on fabrication	1.5	1.5	17
Lucy O’Cull	4/17	Team fabrication and flow rate testing meeting	1	1.0	17.5
Sophie Speece	4/17/2024	Team fabrication and flow rate testing and poster work	0.5	1.0	21
Lucy O’Cull	4/17	Worked on poster	0.5	2.5	19
Emma Flemmer	4/18	Phantom assembly	1	2.5	19.5
Lizzie Maly	4/18	Worked on Poster	1	2.5	17.5
Lizzie Maly	4/18	Retrieved pump	1	3.5	19
Shriya Kaushik	4/17	Team meeting	1	1	15.5

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Shriya Kaushik	4/18	Phantom assembly	3	4	18.5