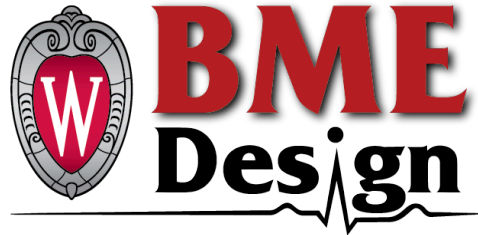


## Progress Report: March 8th - March 15th



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

**Client:** Dr. Giuseppe Toia [gtoia@uwhealth.org](mailto:gtoia@uwhealth.org)

**Advisor:** Prof. John Puccinelli [john.puccinelli@wisc.edu](mailto:john.puccinelli@wisc.edu)

### Team:

Lucy O'Cull (Leader) [ocull@wisc.edu](mailto:ocull@wisc.edu)

Emma Flemmer (Communicator) [eflemmer@wisc.edu](mailto:eflemmer@wisc.edu)

Lizzie Maly (BWIG) [emmaly@wisc.edu](mailto:emmaly@wisc.edu)

Sophie Speece (BSAC) [sspeece@wisc.edu](mailto:sspeece@wisc.edu)

Shriya Kaushik (BPAG) [skaushik6@wisc.edu](mailto:skaushik6@wisc.edu)

## **Problem statement**

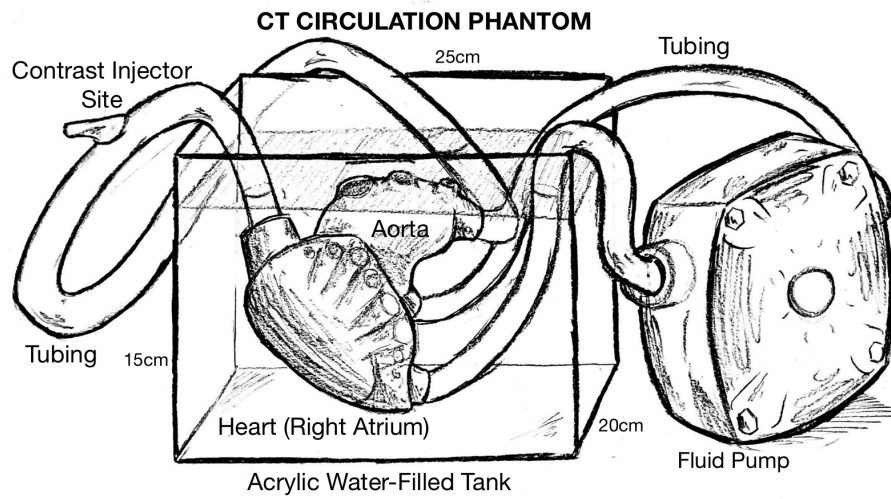
A CT phantom is a device used to calibrate Computed Tomography machines by acting as a “stand in” for human tissues [1]. Most phantoms currently in use are static; they do not allow for dynamic flow. Some patients obtaining a CT scan may need a circulatory support device, such as a VA-ECMO (veno-arterial 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**

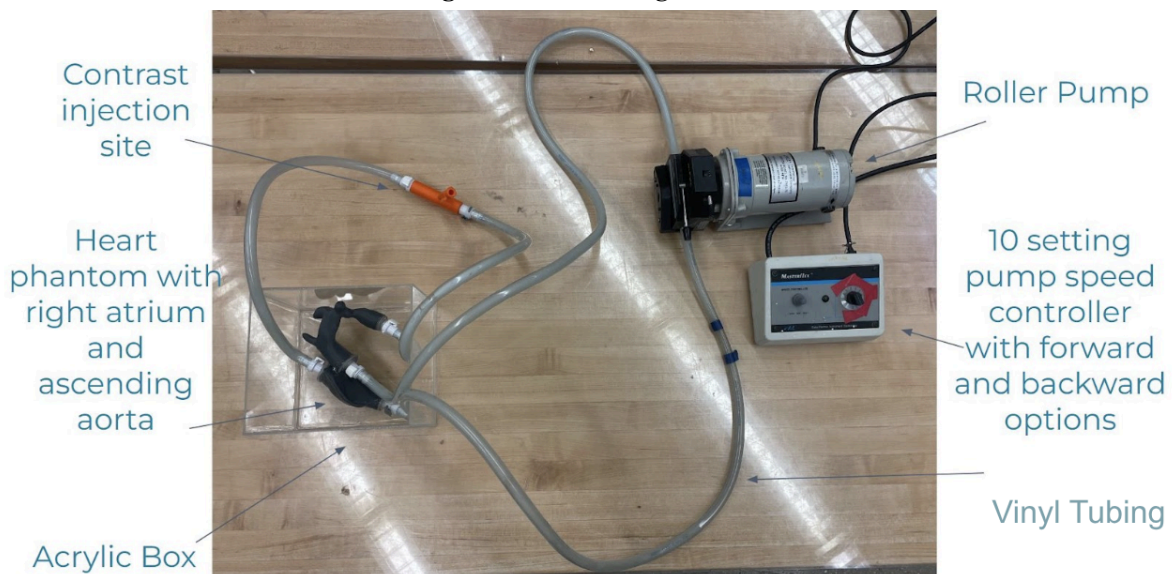
The team is still working on finding the right pump for the system and was provided a few options by the BME teaching lab. Currently, the centrifugal pump is the choice to be tested and the team is working on finding an air compressor to work it. The team is also in prototyping phase. An overall circuit 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

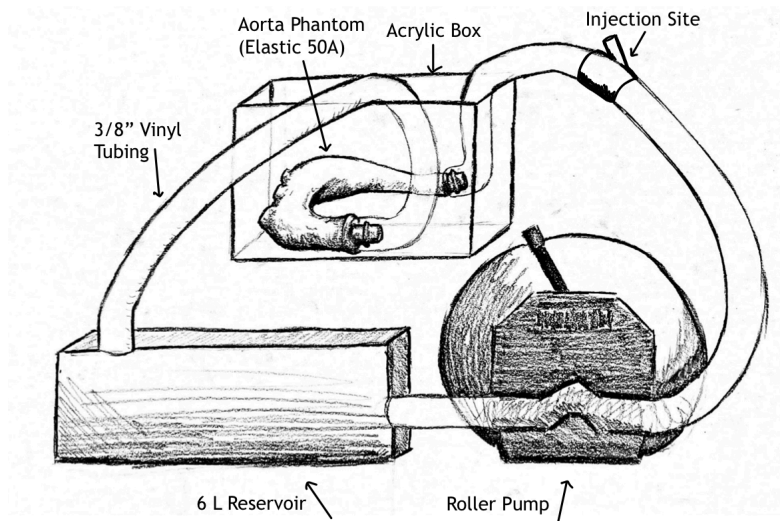


*Figure 1: Final design sketch.*



*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
<b>Category 1- Materials</b>										
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	<a href="#">Makerspace</a>
									\$1.63	
<b>Category 2</b>										
Tubing adapter	Connector to join together $\frac{3}{8}$ inch tubing to $\frac{1}{2}$ inch tubing into the pump	Green Leaf	CBA 3812 BG1	ACE Hardware	48762	3/13/2024	2	2.79	\$5.58	<a href="#">ACE Hardware</a>
									\$0.00	
								<b>TOTAL</b>	<b>\$7.21</b>	

## 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
  - Begin assembling the circuit with the materials from WIMR
  - Work on fabrication and testing protocols
- Emma Flemmer
  - Reach out to the client with the final design plan to get approval
  - Begin assembling the circuit with materials from WIMR
- Sophie Speece
  - Once the team has the green light for purchases, print the aorta phantom out of Elastic 50A Resin
- Lizzie Maly
  - Work on creating fabrication plan for 3D printing
  - Consider options for adhesives to adhere the main structure together
- Shriya Kaushik
  - Meet with team to work on 3d printing modeling
  - Once tubing materials from WIMR are obtained, connect all aspects together and test out circuit with both roller and centrifugal pumps

## Timeline

Task	Jan	Feb				March					April				May	
	26	2	9	16	23	1	8	15	22	29	5	12	19	26	3	10
<b>Project R&amp;D</b>																
Empathize																
Background...	X	X														
Prototyping																
Testings																
<b>Deliverables</b>																
Progress Reports	X	X	X	X	X	X	X									
Prelim presentation					X											
Final Poster																
<b>Meetings</b>																
Client			X													
Advisor	X	X	X	X	X	X										
<b>Website</b>																
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
  - Met with CT techs to get advice on the design
  - Worked with team to determine schematic for circuit
- Emma Flemmer
  - Met with CT techs to get advice on the design
  - Met with Rachel at WIMR to pick up materials
  - Went to ACE hardware to purchase connector adapters
- Sophie Speece
  - Met with CT technicians for feedback regarding the current design.
  - Used said feedback to update phantom 3D model
- Lizzie Maly
  - Met with CT technicians to get design advice
  - Explored 3D printing options that will mitigate support structures
- Shriya Kaushik
  - Worked on Fabrication plans with the team
  - Met with team to discuss a schematic for the entire circuit

## *Activities*

<b>Name</b>	<b>Date</b>	<b>Activity</b>	<b>Time (h)</b>	<b>Week Total (h)</b>	<b>Sem. Total (h)</b>
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

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



Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
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 circuit with team	0.5	0.5	14.00
Shriya Kaushik	3/13/24	Discussed circuit schematics with team	0.5	0.5	11