

Multidimensional imaging-based models for cardiovascular procedural skills training (BVP model)

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Team: Hunter Belting, belting@wisc.edu (BSAC)

Anna Balstad, abalstad@wisc.edu (Communicator)

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Problem Statement

Interventional cardiology is a rapidly expanding field in veterinary medicine. Pulmonary valve stenosis occurs when a dog is born with a malformed pulmonary valve, which restricts blood flow from the right heart to the lungs. Balloon valvuloplasty is a palliative procedure in which a balloon-tipped catheter is inserted into the jugular vein to the valve and is then inflated to help reduce the severity of the stenosis. Recently, the UW-Madison School of Veterinary Medicine has experienced a decrease in caseloads of canines with pulmonary valve stenosis, preventing the cardiology residents from being able to practice repairing this disorder. There is a need for a heart model to mimic pulmonary valve stenosis for residents to learn and practice repairing these valves.

This device, a model-based simulation program will be implemented to maintain the cardiologists' surgical skill set and to aid in cardiology resident training. Simulator training using multidimensional imaging-based models will augment the training already provided in the interventional lab and help protect against the ebb and flow of procedural caseload eroding skills. It also provides a more consistent experience for our residents and provides an objective method of assessing individual progress amongst our trainees.

The goal is to develop a silicone 3D model of canine pulmonary valve stenosis which can be used to learn/practice essential skills like handling of guidewires/catheters, balloon positioning and inflation, and communication between veterinary interventionists. Computed tomography angiography (CTA) of dogs with pulmonary valve stenosis will be used to create the 3D models, which will be secured in place. Lastly, a document camera will project an image of what the user is doing with their hands onto a screen. This provides a more realistic recreation of the interventional surgery, where the surgeon watches a fluoroscopy screen to monitor the movement of the interventional equipment inside the patient.

Summary of Weekly Team Member Design Accomplishments

- Team:
 - Reviewed and submitted executive draft
 - Continued development of model with client
- Hunter Belting:
 - Reviewed and edited the executive draft
 - Met with the client to test the model
 - Made physical edits to the model such as sanding and lubricating to prep for the Friday meeting
- Anna Balstad:
 - Finished writing the executive draft summary
 - Met with client to test model
 - Helped to smooth the walls of the ventricles
- Rebecca Poor:
 - Gathered supplies for continual development of model
 - Edited executive draft summary
- Daisy Lang:
 - Purchased industrial lubricant for testing model
 - Updated expense report

Weekly / Ongoing Difficulties

N/A

Upcoming Team and Individual Goals

- Team:
 - Continue writing final report
 - Finalize design/fabrication of model
 - Recruit subjects for testing
- Hunter Belting:
 - Volunteer at the Engineering Expo for outreach
 - Work with the client to continue to finalize the model
 - Begin full testing of the model
- Anna Balstad:
 - Continue model testing
 - Volunteer at Engineering Expo
 - Continue writing final report and start poster
- Rebecca Poor:
 - Assist in model testing
 - Divide up portions of final report/poster
 - Outreach event!!
- Daisy Lang:
 - Begin scheduling model testing with students
 - Make plan for analyzing results of model testing

Project Timeline

Project Goal	Deadline	Team Assigned	Progress	Completed
Preliminary Presentation	2/7	All	100%	X
IRB	02/26	All	100%	X
Preliminary Report	2/26	All	100%	X
Executive Summary Draft	4/18	All	100%	X
Final Poster Presentation	4/25	All		
Final Deliverables	4/30	All		

Expenses

Running Total: \$616.07

Link to spreadsheet:

<https://docs.google.com/spreadsheets/d/1zrmdodVMY9Tak7XrOgHdQ6oMQDw5IYqgROYaAgW1NkOQ/edit?usp=sharing>

Item	Description	Manufacturer	Manufacture Part Number	Vendor	Date	QTY	Cost Each	Total	Link
3D Printed Materials									
Elastic 50A	Heart and Jugular Material	Formlabs	RS-CFG-ELCL-02	Formlabs	10/14/2024	1	\$208.57	\$208.57	https://formlabs.com/store/materials/elastic-50a-resin-v2/
Flexible 80A	Original Material for Heart	Formlabs	RS-CFG-FL80-01	Formlabs	10/14/2024	1	\$208.57	\$208.57	https://formlabs.com/store/materials/flexible-80a-resin
Model Materials									
Super Glue	Secure Jugular to Heart and Stand to Base Plate: 0.07 oz Tube	The Original Super Glue Corporation	SGH2J	Makerspace	11/19/2024	2	\$2.42	\$4.84	https://supergluecorp.com/product/super-glue-tube/
3D Printed Stand	PLA Prints of stand to hold the Jugular and Heart	N/A	N/A	Makerspace	11/19/2024	2	\$8.00	\$8.00	N/A
Acrylic Base Plate	Secure the Model	N/A	N/A	Makerspace	11/19/2024	1	\$0.00	\$0.00	N/A
Full Model Tank	Tank to hold the entire model submerged in water: Superio Clear Storage Box with Lid, 44 Quart Plastic Container	Superio	B0D8518W1F	Amazon	3/3/2025	1	\$34.01	\$34.01	https://www.amazon.com/Superio-Container-Organizing-Stackable
Industrial Lubricant	Coat the inside of the model to help the catheter slide easily through	Super Lube Kano Laboratories LLC		56204 Amazon	4/3/2025	1	\$8.94	\$8.94	https://www.amazon.com/Super-Lube-56204-Silicone-Lubricant/dp/
HDMI Adaptor Cord	Adaptor Cord to connect phone to monitor to project video of model for testing JSALUX USB C to HDMI Cable 10ft 4K@60Hz USB 3.1 Type C to HDMI 2.0 Cord for Home Office, (Thunderbolt 3/4 Compatible) with iPhone 16 Pro Max, MacBook Pro/Air, Galaxy S8 to S24, iPad Pro, iMac-Black	JSALUX	USB-C to 4K@60Hz HDMI Cable	Amazon	4/3/2025	1	\$13.99	\$13.99	https://www.amazon.com/dp/B0BQB8M4V5V?ref=cm_sw_r_cso_sfr
Water Proof Super Glue	Secure model stand to the base of tank Flex Glue, Mini, White, Super Strong, Rubberized Waterproof Adhesive, Works Underwater, Use On Pools, Showers, Outdoors, Concrete, Brick, Pavers, Masonry, and UV Resistant, 0.75 fl oz	Swift Response, LLC	B07PNQPF6G Flex Glue Mini Strong Rubberized Waterpr	Amazon	4/3/2025	1	\$5.78	\$5.78	https://www.amazon.com/Flex-Strong-Rubberized-Waterproof-Adh/
Phone Stand	Phone Tripod Stand, 85" Tall Cellphone Tripod with Gooseneck Remote, Flexible Tripod Stand for iPhone, Portable Phone Stand Tripod for Recording, Compatible with iPhone 14 13 12 pro Android Cell phone	Vivitiv	p18-353	Amazon	2/13/2025	1	\$21.99	\$21.99	https://www.amazon.com/Cellphone-Gooseneck-Flexible-Recording
Pump Materials									
Perisaltic Pump	900ml/min high Flow peristaltic Pump 12V dc Brush Motor Liquid dosing Pump with BPT Tube	Kamoer	KPHM900-HB-B24	Amazon	2/7/2025	1	\$58.88	\$58.88	https://www.amazon.com/dp/B0B875XPFX/ref=sppa_dk_detail_1?
Tubing	10 Feet - 1/4" ID x 3/8" OD Clear Vinyl Tubing, Translucent Plastic PVC Tubing Hose Pipe for Water Air Pump	Kesoto	601279606865	Amazon	2/13/2025	1	\$6.99	\$6.99	https://www.amazon.com/Kesoto-Clear-Translucent-Plastic-Tubing
Small Hose Clamps	3/8" Heavy Duty Double Snap Grip Nylon Hose Clamps Several Ratcheting Adjustable Clamp	Quickun	767065462036	Amazon	2/13/2025	1	\$11.59	\$11.59	https://www.amazon.com/Quickun-Double-Several-Adjustable-Clamp
Circuit Switch	6A 250V/ 10A 125V Circuit Switch	ELMA	39122226	Makerspace	2/18/2025	1	\$0.20	\$0.20	https://www.yorklighting.com/brand-elma-products-en?l=low-metal-round-rocker-switch-w-diode-2-circuit-rated%3A-6a-250v-10a-125v/aku-v27-80-2101
Project Box	Zulkit Junction Box ABS Plastic Dustproof Waterproof IP67 Junction Boxes Universal Electrical Project Enclosure DIY Electronic Project Box Grey 7.87 x 5.91 x 5.12 inch (200 x 150 x 130 mm)	Zulkit	B08MYWTF6D	Amazon	3/3/2025	1	\$18.98	\$18.98	https://www.amazon.com/Zulkit-Dustproof-Waterproof-Electrical-Electronic/dp/
Large Hose Clamps	12-3-14-2mm - 0.48-0.55in - Plastic Hose Clamp - Herbie Clip - Black - PP	HCL	HCL HC-D-PP-BK	HCL	3/3/2025	10	\$0.57	\$5.70	https://hcl-clamping.com/products/plastic-hose-clamp-herbie-clip-12-3-14-2mm
Power Adaptor	12V DC 1.5A-2A Converter Adapter Power Supply Power Cord Power Cable Charger DC Power Supply Plug 5.5mm x 2.5mm	ShenZhen Moveforest Electric Appliance Industry Co.,LTD	9553171318326	Amazon	2/18/2025	1	\$7.89	\$7.98	https://www.amazon.com/1-5A-2A-Converter-Adapter-Supply-Charger/dp/B0CNV6BHL7/ref=asc_df_B0CNV6BHL7/moid=c2c693d820b3e4594cd0f95ca88b844hvojcjje4882312312521876959-B0CNV6BHL7-&hvxexpm=73&tag=hyprod-20&linkCode=rd&hvadid=7303128205988&hpos=&hvmetw=g&hvrand=482312312521876959&hvpos=&hvptw=&hvqgn=&hvdev=c&hvdcid=&hvllocint=&hvlvloc=9018944&hvtagid=pla-2281435178298&psc=1
							TOTAL:	\$616.07	

