



Emergency Cricothyroidotomy

Preliminary Presentation

2/9/2024

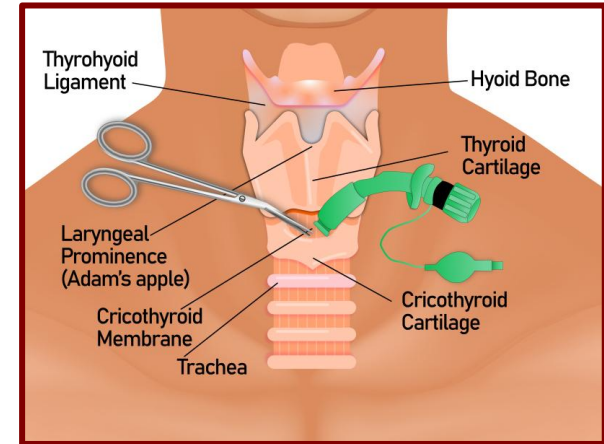
Team: Zac Mayhew, Kat Smereka, Megan Finell, Mateo Silver

Advisor: Dr. Darilis Suarez-Gonzalez

Client: Dr. Lenard Markman

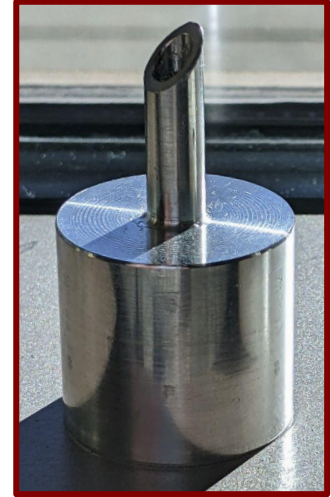
Problem Statement

- Current devices require multiple moving parts
- Specialized training is required to operate
- Time is extremely valuable while choking
- Need for simpler device



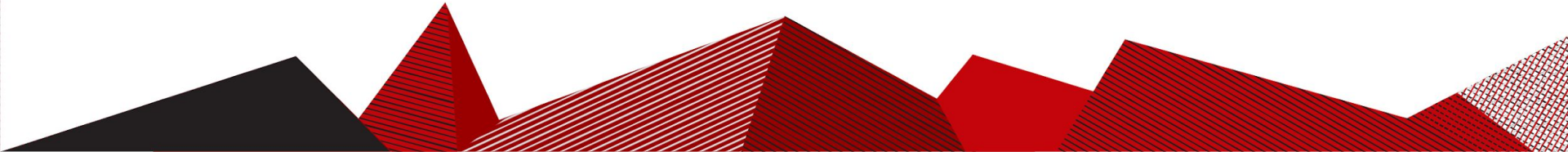
Design Constraints

- Non-ferrous material
- Inclusive of the general population
- Adaptable to BVM
- Incorporate multiple parts into one
- 500 mL of air exchange every 3 seconds
- Fit in first aid kits and carried easily



Clinical Relevance

- > 4000 choking deaths per year in the US [1]
- Average EMS arrival time is 7 minutes [2]
- Heimlich maneuver is 86.5% successful [3]
- Permanent brain damage likely after 4 minutes [4]



Summary of last semester

Criteria	Weight	Design 1: The Lancet	Design 2: The Hole Puncher	Design 3: Captain Hook
Ease of Use	25	5/5 (25)	4/5 (20)	3/5 (20)
Portability	25	4/5 (20)	5/5 (25)	3/5 (15)
Cost	20	2/5 (8)	5/5 (20)	4/5 (16)
Ease of Fabrication	15	3/5 (9)	5/5 (15)	4/5 (12)
Ergonomics	10	5/5 (10)	3/5 (6)	4/5 (8)
Safety	5	5/5 (5)	3/5 (3)	2/5 (2)
Total:	100	77	89	73

Figure 3. Design matrix detailing three designs

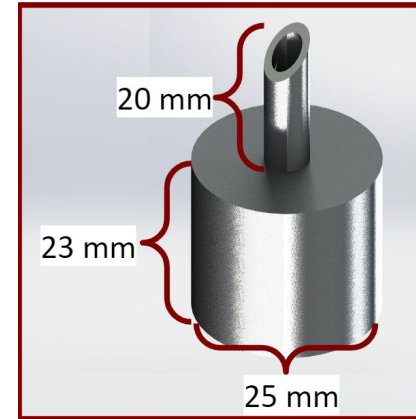


Figure 4. Final design

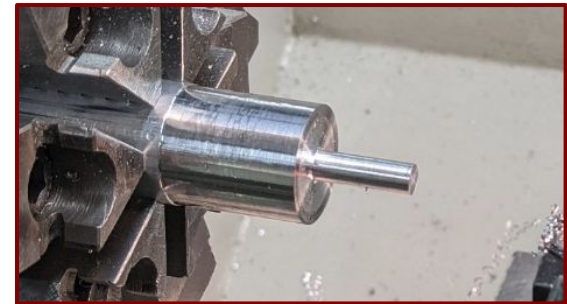


Figure 5. Fabrication on the lathe

Summary of last semester

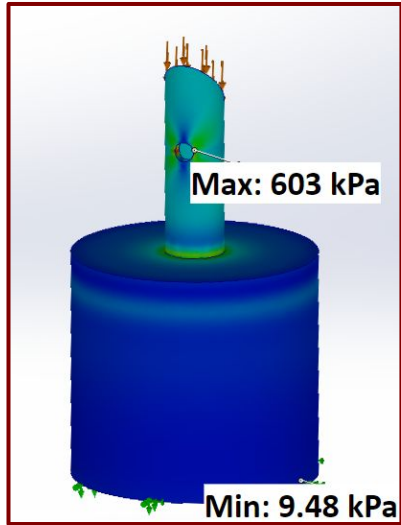


Figure 6. CAD Testing



Figure 7. Skin Mimic setup

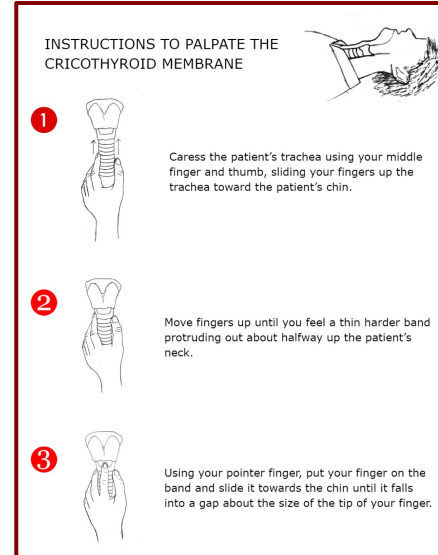


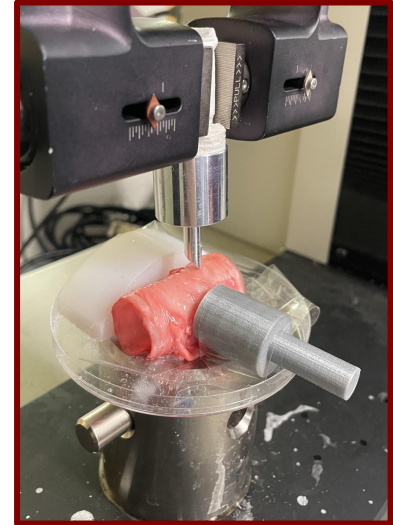
Figure 8. Survey Instructions

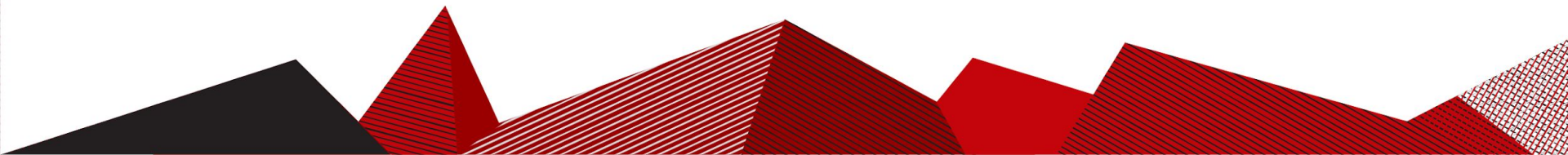
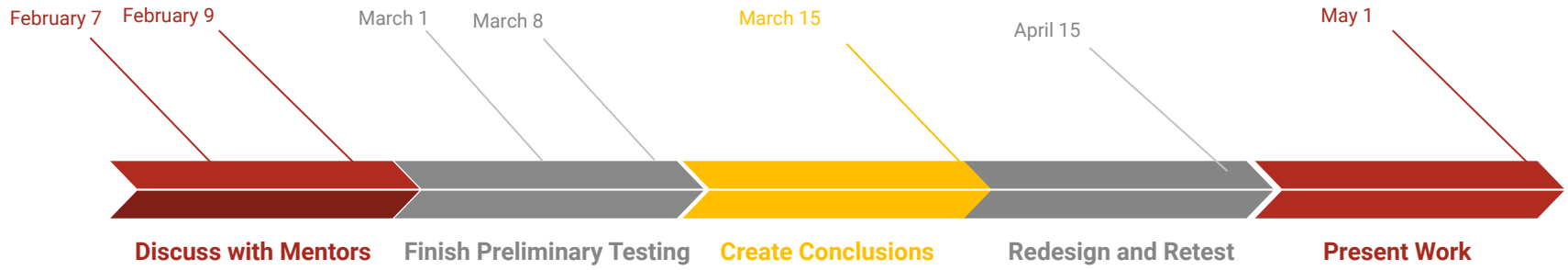


Figure 9. MTS Testing

Specific aims

1. Quantify puncture force and pressure parameters in animal models
2. Quantify airflow delivery metrics with a BVM attachment
3. Optimize design for ultimate performance

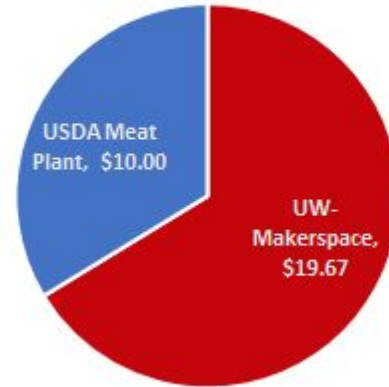




Fall 2023 Budget

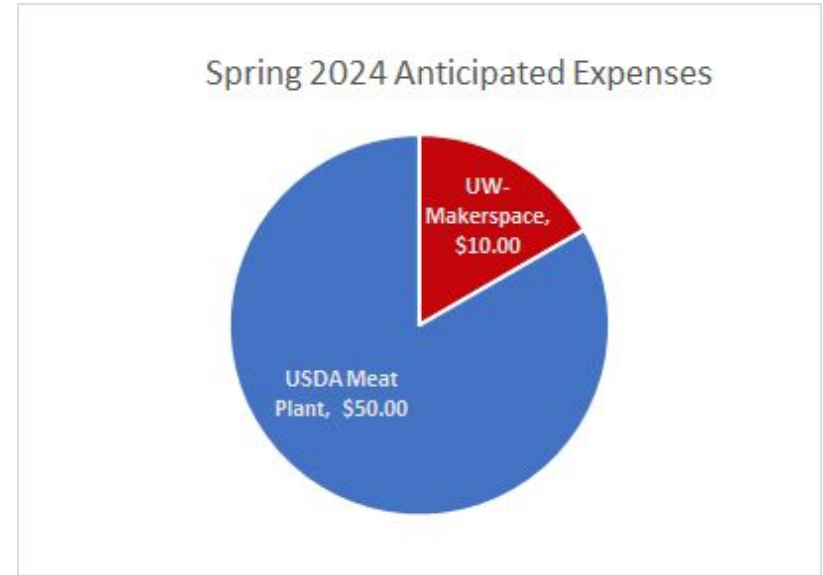
Item	Supplier	Total
PLA Print of Design	UW-Makerspace	\$0.16
3D Print of Trachea	UW-Makerspace	\$6.24
3D Print of Larynx	UW-Makerspace	\$10.41
PLA Print of Prototype	UW-Makerspace	\$0.38
PLA Print of Prototype	UW-Makerspace	\$0.48
Porcine Larynx	USDA Meat Plant	\$10.00
3D printed grips for the MTS machine	UW-Makerspace	\$2.00
TOTAL:		\$29.67

Fall 2023 Spending Summary



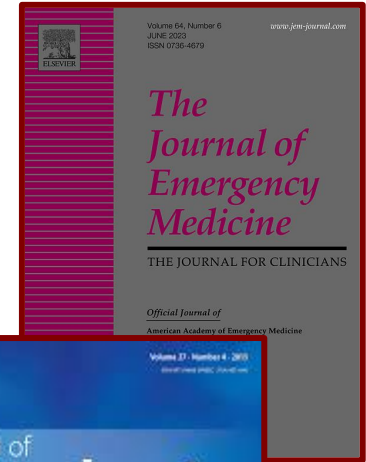
Spring 2024 Anticipated Expenses

Item	Supplier	Total
5 x Porcine Larynx	USDA Meat Plant	\$50.00
3D printed fixation device for the MTS machine	UW-Makerspace	\$10.00
TOTAL:		\$60.00



Journal for Publication

- Previous BME teams
 - Undergraduate journals, Tier of journal to publish in
 - Range of subject specific journals, median impact factor 2.4
- Similar medical devices
 - Common testing methods, sample size
 - Porcine models and mannequins, $n \approx 40$
- Prior Research
 - J Med Dev, Anaesthesia, J. Emerg. Med
 - Mostly covered techniques and educational methods, not novel devices



Outreach Information

- BadgerBOTS
 - Local high school robotics club
 - Middleton, WI
- Confirmed possibility of event, still finalizing date
- Biomechanics-related activity
 - Reaching out to Dr. Puccinelli about possible activities?



BUILD • DEVELOP • CREATE • INSPIRE





Questions?



References

[1] “The Heimlich Maneuver: Breaking Down the Complications | SMJ.” Accessed: Sep. 30, 2023. [Online].

[2]“Emergency Medical Services Response Times in Rural, Suburban, and Urban Areas - PMC.” Accessed: Sep. 19, 2023. [Online].

[3] C. Wang, Z. Wang, and T. Wang, “Blunt myocardial injury and gastrointestinal hemorrhage following Heimlich maneuver: A case report and literature review,” *World J. Emerg. Med.*, vol. 13, no. 3, pp. 248–250, 2022, doi: 10.5847/wjem.j.1920-8642.2022.038.

[4] “CPR - adult and child after onset of puberty: MedlinePlus Medical Encyclopedia.” Accessed: Sep. 30, 2023. [Online].

