BME Design-Spring 2024 - KATERINA SMEREKA
Complete Notebook

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KATERINA SMEREKA

on

May 01, 2024 @10:56 PM CDT

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Team contact Information

Megan Finell - Jan 31, 2024, 9:12 PM CST

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
		Advisor			
		Client			
		Leader			
		Communicator			
Finell	Megan	BSAC	finell@wisc.edu	(262)388-2350	
		BWIG			
Finell	Megan	BPAG	finell@wisc.edu	(262)388-2350	

Project description

John Puccinelli - Aug 14, 2013, 12:01 PM CDT

Course Number:

Project Name:

Short Name:

Project description/problem statement:

About the client:

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3/3/2024 - 2/7/2024 Client Meeting

Megan Finell - Mar 03, 2024, 4:10 PM CST

Title: Initial Client Meeting this Semester

Date: 3/3/2024

Content by: Megan

Present: Dr. Lenard Markman, Mateo, Zac, Megan

Goals: Discuss the current state of the project and timeline for this semester. Ask for feedback on the device from the client.

Content:

Notes the client had on the aluminum prototype:

- Likes how the device is gripped and doesn't necessarily think there needs to be a handle.
- Likes that the opening is wide enough to comfortably breathe through.
- Consider methods of sterilization.
- Likes that the device is very low cost.

Design ideas:

- The shank could be conical in design and become bigger towards the BVM compatible side to stop the bleeding (aka plug the puncture wound).
- Could add a grip similar to a syringe to make it easier to generate force.
- Definitely need to be sharpened.

Clinical interest:

- Dr. Markman has described the basics of our device to many doctors/EMTs/paramedics that are interested in it.
- They think it is a smart option to have in case of emergency.

Possible marketing considerations:

- Easy to market to EMS conference (700+ people involved in emergency medicine there).
- Brough up questions on pricing.
- Could give to paramedics/sell at conferences.

Conclusions/action items:

Overall, the client was very happy to see our progress and was confident in the completed prototype. He also brought up important considerations of sharpness, sterilization, and ergonomic grip.

3/1/2024--Advisor Meeting

KATERINA SMEREKA - Mar 01, 2024, 1:02 PM CST

Title: March 1, 2024 Meeting

Date: March 1, 2024

Content by: Katerina

Present: Mateo, Megan

Goals: See what next steps are

Content:

- **recap what we did**
- **get access to a scalpel and compare the forces**
- **not quantitative**
    - **have a control**
    - **positive control for comparison**
- journal selection is very hard
- maybe annals of emergency medicine
- maybe biomedical devices journal
- is a very clear application of emergency medicine
- what is in the methods
    - need to expand on fabrication
        - mention teamlabs
        - mention solidworks
        - solidworks cad testing
- all depends on the focus on the journal
- since we are doing more generic; could be tailored both ways
    - adding doesn't hurts

- it is defintely worth to ask the uw madison meat plant to see if they can give a whole neck
- a ring and a piece that goes in
- do we have to scale up our device
- how does a pig translates to a human size
- wimr probably doesn't have pigs
- would be easier to reach out for meat plant facility
- how long would the whole process would take
- especially since time is of the essence
- figuring out how to approach that--with pigs of course
- compare it to a scalpel and see if that is any easier
- maybe use a trained professional
- size of the puncture wound
- direct comparison: testing total time, outcomes, structural damage

Conclusions/action items:

next steps include talking to more butchers and seeing if we can have a whole ensemble and see if we can test on that. Then maybe comparing to a scalpel routine and seeing if a professional could do it

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Expenses and Invoices

Megan Finell - May 01, 2024, 9:26 PM CDT

Title: Expenses and Invoices for this semester

Date: 5/1/2024

Content by: Megan Finell

Present: N/A

Goals: Outline the expenses made this semester and include invoices.

Content:

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Semester 1 Expenses										
All expenses									$29.67	
Semester 2 Expenses										
Porcine Skin	Tissue sample to be used in testing of the prototype.	N/A		Asian Midway Market		2/10/2024	1	2.97	$2.97	
Porcine larynx/trachea	Tissue samples to be used in testing of the prototype.	N/A		USDA UW Madison Meat Plant		4/8/2024	3	15	$45	
Porcine Skin	Tissue sample to be used in testing of the prototype.	N/A		Asian Midway Market		4/11/2024	1	2.97	$2.97	
Porcine Skin	Tissue sample to be used in testing of the prototype.	N/A		Asian Midway Market		4/23/2024	1	2.97	$2.97	
								TOTAL:	$83.58	

Purchases this semester:

- Porcine skin (3 times) from a local Madison market
  - No receipts were given at the Asian Midway Market
- Porcine larynges and tracheas
  - we were given 5 but were only charged for 3 from the USDA UW Madison Meat Plant

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON
Animal & Dairy Science Dept

INVOICE
Invoice No: AR0195820
Invoice Date: 4/15/24
Page: 1 of 1

Bill To:

Biomedical Engineering
Megan Finell
1550 Engineering Drive
1220 Engineering Centers
Madison WI 53706
United States

Customer Number: 194200
Order Number: USDA Apr8
Order Date 04/12/2024
4/8/24 Thru 4/8/24
AMOUNT PAID: 45.00 USD

THIS INVOICE HAS BEEN PAID VIA INTRA-UNIT BILLING. NO ACTION ON YOUR PART NEEDED.

For billing questions, please call 608/262-1244

Line	Identifier	Description	Quantity	UOM	Unit Amt	Original Net Amount
1	MSABD	Pork Esophagus	3.00	EA	15.0000	45.00

This line item has been charged to your funding: 194200-233-2-2650-PRJ42BY
BME Department - Megan Finell picked up pork larynx/trachea

Total Paid: 45.00

Funds were granted by the UW Madison Department of Biomedical Engineering to pay for the porcine larynges and tracheas.

Conclusions/action items:

The team was resourceful in locating free parts and scrap metal to use for fabrication. This semester, the only expenses were on porcine tissues for testing.

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2024/03/03 - Fabrication Protocol

Mateo Silver - Mar 03, 2024, 1:19 PM CST

Title: Fabrication Protocol

Date: 3/3/2024

Content by: Zac, Mateo, Megan

Present: Zac, Mateo, Megan

Goals: The goal of this document is to outline the fabrication protocol so in the future we can follow it to make multiple devices.

Content:

Machining on Lathe

1. **Setting up the lathe:** Measure the diameter of the aluminum stock. Place the aluminum stock in the chuck with approximately 2 inches hanging out. Insert the cutting tool into the tool post, and set the machine into high gear. Make sure to rotate the chuck while changing gears to allow them to mesh. Pull the spindle lever upwards to start the lathe. Adjust the RPM of the machine to approximately 1000 RPM. If machining the part out of a different material, consult the RPM tool to determine the correct RPM. The chuck should be spinning counterclockwise.

2. **Zeroing the Z-axis:** Do this by moving the tip of the cutting tool towards the face of the part. Once light contact is made, use the x-axis handwheel to move the tool off the face of the part. Stop the machine and zero the z-axis on the DRO. Turn the z-axis handwheel until the DRO reads -0.015”. Zero the DRO again, and face off the part. Make sure to only move the x-axis handwheel when facing off.

3. **Setting the X-axis diameter:** Move the cutting tool along the z-axis until it is along the edge of the part. Slowly turn the x-axis handwheel clockwise until light contact is made against the diameter of the part. Turn the z-axis handwheel clockwise to move off of the part. Make sure not to move the x-axis handwheel at this time. Turn the machine off, and set the x-axis measurement on the DRO to the measured diameter of the stock.

4. **Cutting the major diameter:** Set the x-axis on the DRO to the outer diameter of the part, 0.990”. Moving only the z-handwheel, take the cutting tool down the length of the part, stopping about 0.2” before the spindle. Stop the spindle and measure the diameter of the part. Update the DRO diameter reading if the numbers do not match. Make a final pass to create the actual outer diameter of 0.9843”. Move slowly to ensure a good surface finish.

5. **Cutting the minor diameter:** While taking 0.03” cuts, move the cutting tool to -0.7800 in the z-axis. Continue cutting until a diameter of 0.25” in reached. This should take about 26 cuts. Now do the final pass. Set the x-axis to the final part diameter, 0.2362. Move the cutting tool down the length of the part until the final length is reached, -0.7874”. Slowly turn the x-handwheel counterclockwise to remove the cutting tool from the face.

6. **Spot drilling the minor diameter channel**: Remove the cutting tool from the tool post. Place the keyless chuck into the tailstock. Secure the spot drill into the chuck. Move the tailstock towards the part, lock it in place. Touch the spot drill to the face of the part and zero the digital readout. Retract the chuck away from the material and turn the spindle on at approximately 800 RPM. Spot drill until a readout of -0.04” is reached.

7. **Drilling the minor diameter channel:** Next, the 0.1572” diameter channel will be drilled out. Use a 5/32” bit, or a more accurate drill bit if available. Turn the spindle on at 1000 RPM. Peck drill until a depth of approximately 1.000”. Make sure to completely remove the bit out of the hole while drilling to remove debris.

8. **Cutting off excess stock:** Using the drop saw, cut the excess stock off of the part. For aluminum, the drop saw should run at 200 RPM. Leave an extra 0.1” or so the part can be machined to it’s final length. For example, the final part length is 1.6929”, so make the cut at 1.8”

9. **Cutting the part to its final length:** Measure the length of the major diameter section. Place the part back in the lathe chuck, with the major diameter facing outwards. Set the cutting tool into the tool post, and face off the part. Set the z-axis DRO to the measured length. Taking 0.03” cuts, cut the length of the part down to 0.92”. On the final pass, take a cut at 0.9055”, moving the x-handwheel slowly to ensure a good surface finish.

10. **Spot drilling the major diameter channel:** Remove the cutting tool and place the spot drill into the keyless chuck. As before, zero the spot drill against the face of the material. At 800 RPM, spot drill until a depth of -0.04”.

11. **Drilling the major diameter channel:** Finally, the 0.8661” diameter channel will be drilled. Use a 55/64” bit, or a more accurate drill bit if available. Turn the spindle on at 275 RPM. Peck drill until a depth of approximately 0.7874”. Make sure to completely remove the bit out of the hole while drilling to remove debris. Next, replace the bit with an flat end mill of the same diameter. At as slow an RPM as possible (~237 RPM), drill down to the same length as before. This creates the flat bottom of the channel

12. **Part Deburring:** Move the carriage away from the chuck. Then, at 300 RPM, use a file to knock off the sharp edges. File down all sharp edges, on both sides of the part. Use swivel head deburring tools to clean up the inside of the minor diameter channel.

Machining on Mill

6. **Setting up the Mill:** Place the piece in a 63/64” collet block to secure it. Using a 45° angle block, clamp the piece down at an angle. Place a ½” 2-flute aluminum endmill in the collet, and load the collet into the spindle.

7. **Zeroing the z-axis:** Align the tip of the part with the drill bit. Turn the mill on at 1000 RPM. Raise the z-axis upwards until contact is made with the part. Zero the z-axis on the DRO.

8. **Creating angled edge:** Removing ten thousandths of material in each pass (0.01”), begin taking material off the end of the tip. Make sure to use cutting oil for lubrication and cooling. One may need to move the part in the x and y axes to ensure the entire tip is machined. Move more slowly as you begin taking off more material with each pass. Stop when a z depth of -0.167” is reached.

9. **Removing the endmill:** Remove the part from the clamp and turn it over so that the longer end of the needle is facing upwards. Reclamp the piece and lower the table. Ensure that the quill is all the way up and locked, then remove the collet and endmill. Load the keyless chuck into the spindle and place the edge finder into the chuck.

10. **Zeroing the y-axis:** Maneuver the table and quill until the edge finder is along the side of the shaft. Turn the mill on at 800 RPM. Slowly move the edge finder until it makes contact with the side of the shaft closest to you. Keep going until the edge finder begins to break the other way. Raise the quill and zero the y-axis on the DRO. Compensate for the radius of the edge-finder by setting the y-readout to 0.250”, then zero again. Next, use the edge finder to locate the edge of the other side of the shaft. Make sure to compensate for the

radius of the edge finder. Note the diameter of the shaft you just found. Zero the y-axis again, so that it it zero at the edge of the shaft. Move the y-axis the distance of the radius of the shaft and zero it one last time.

11. **Zeroing the x-axis:** Place the edge finder near the tip of the shaft, where the y-axis DRO reads 0.0000. Gradually turn the x-handwheel until the edge finder makes contact, then breaks the other way. Zero the x-axis on the DRO. Remove the edge finder from the keyless chuck.

12. **Spot drilling the additional hole:** Place the spot drill into the keyless chuck. Move the part until the DRO reads 0 in the y-axis and -0.345 in the x-axis. Bring the quill down until it touches the part, then zero the quill readout. Turn on the spindle at a speed of 1000 RPM. Tap the spot drill until it just makes contact. Make sure not to drill too far as to make a spot drill hole which is larger than the drilled hole. Remove the spot drill from the keyless chuck.

13. **Drilling the additional hole:** To create the additional hole, which has a 0.0787” diameter, use a 5/64” bit , or a more accurate drill bit if available. Lower the quill until the bit touches the part and zero the quill readout. At 1500 RPM, drill through only one side of the shaft, approximately a depth of 0.03935”.

14. **Part Deburring:** Use a file to deburr the angled edge created. Use a swivel head deburring tool to reach the inner portion of the angled edge. Finally, use a countersink deburring tool to clean up the additional hole.

Sharpening on Belt Sander

1. **Marking lancet cut:** Using a permanent marker, mark out the shape of the lancet. Starting at the pointed end of the device, draw a line on the outer shaft of the needle. The line should follow the angled edge of the tip, about 3 mm from the edge, until halfway around the shaft. The figure below illustrates the shape of the needle before and after [1].
2. **Sanding:** Use a belt sander to create the lancet tip along the marked line. The tip should come to a point, with sharp edges along the side of the lancet

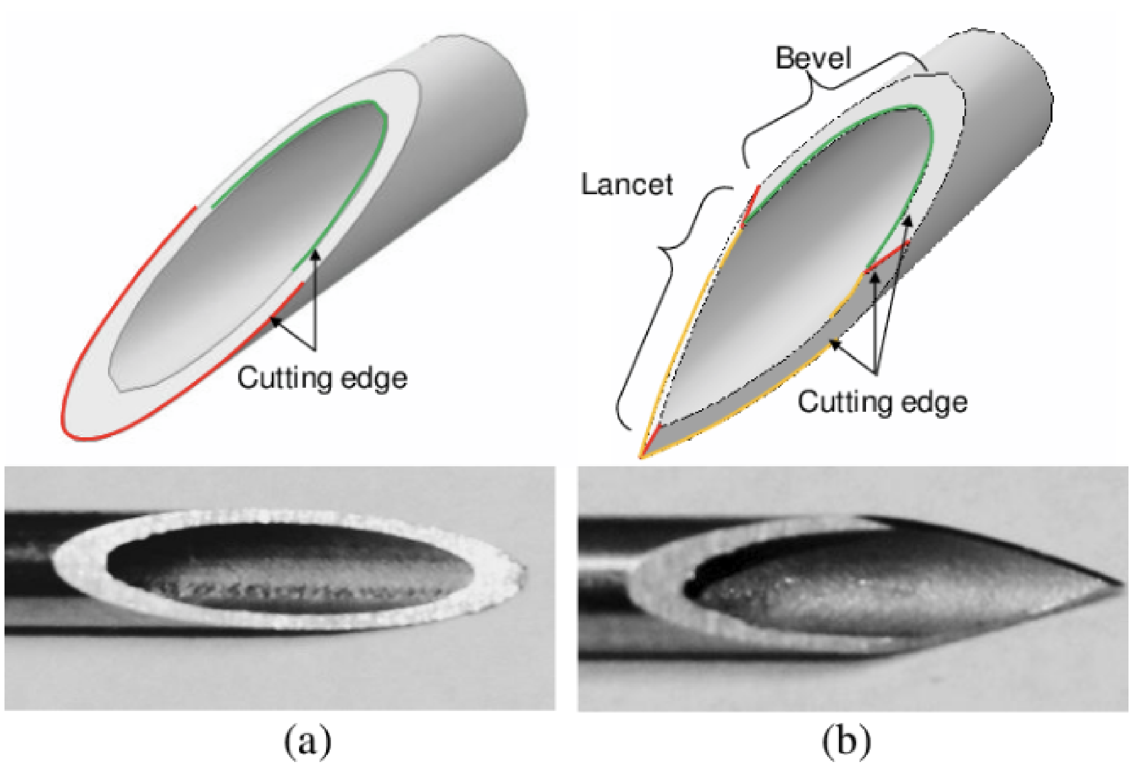


Figure 1 CAD and actual models of (a) bias bevel and (b) lancet tip needle

References:

[1] B. L. Tai, Y. Wang, and A. J. Shih, “Cutting Force of Hollow Needle Insertion in Soft Tissue,” in *Volume 1: Processing*, Madison, Wisconsin, USA: American Society of Mechanical Engineers, Jun. 2013, p. V001T01A007. doi: 10.1115/MSEC2013-1124.

Conclusions/action items:

Next semester we will refer to this document when we are creating more prototypes and possibly prototypes of different sizes.

2024/03/03 - Part Drawing

Mateo Silver - Mar 03, 2024, 1:23 PM CST

Title: Part Drawing

Date: 2024/03/03

Content by: Mateo Silver

Present: n/a

Goals: Create part drawing to use in manufacturing.

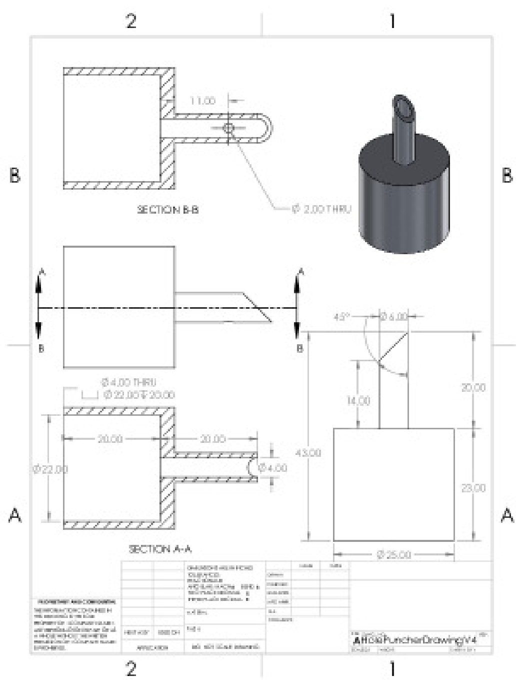
Content:

Using our solidworks design, we have created a part drawing with all the measurements needed to fabricate the part annotated. This drawing is intended to serve as a guide, along with the fabrication protocol, to aid in proper fabrication of the device.

Conclusions/action items:

Refer to this drawing during part fabrication.

Mateo Silver - Mar 03, 2024, 1:23 PM CST



Download

HolePuncherDrawingV4.pdf (115 kB)

4/21/2024--Timing Protocol

KATERINA SMEREKA - Apr 21, 2024, 5:58 PM CDT

Title: Timing Protocol

Date: April 21, 2024

Content by: Katerina

Present: N/A

Goals: Outline how timing test will be performed

Content:

Set Up:

1. Thaw larynx according to other protocol
2. Set out skin size fittting the trainer
3. Fix skin to trainer
4. Insert the porcine larynx under the skin
5. Bag the device

Testing:

1. Have subject face the trainer and bagged device
2. Supervisor say 'go'
3. Start timer when the subject opens the bag with the device
4. Stop timer when BVM delivers air to device

Requirements:

- Subject must palpate for cricothyroid membrane
- When delivering air, air should be felt coming through one side of the trainer
- After timer has stopped, the larynx should be removed--if the device moves with the larynx, this validates success

Conclusions/action items:

Talk with the team about more specifications or edits to be made

3/3/2024 - 2/14 Testing

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Megan Finell - Mar 03, 2024, 4:45 PM CST

Title: 2/14 Testing

Date: 3/3/2024

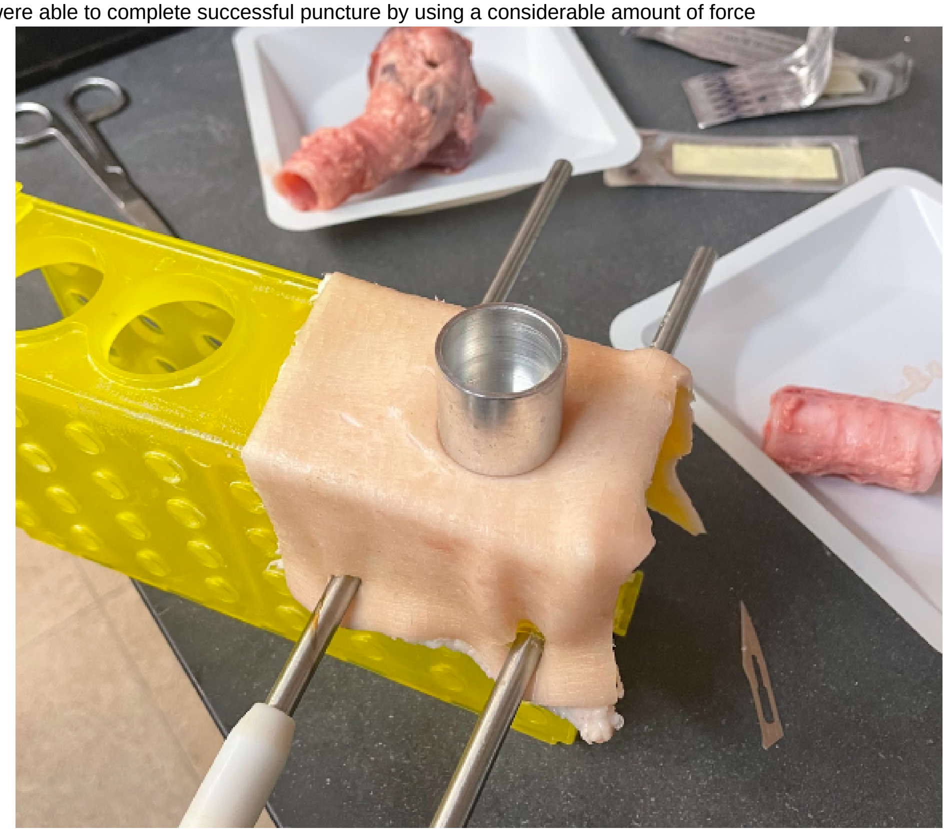
Content by: Megan

Present: Megan, Kat, Mateo, Zac

Goals: Complete qualitative testing on porcine larynx, trachea, and skin. Evaluate how each prototype (3D printed, aluminum, and client's prototype) performs.

Content:

Aluminum prototype:

- Skin:
  - We were able to complete successful puncture by using a considerable amount of force
    - 
  - Had to design a testing setup that kept a piece of skin under tension
    - This setup consisted of two rods and a test tube holder with the skin stretched over it

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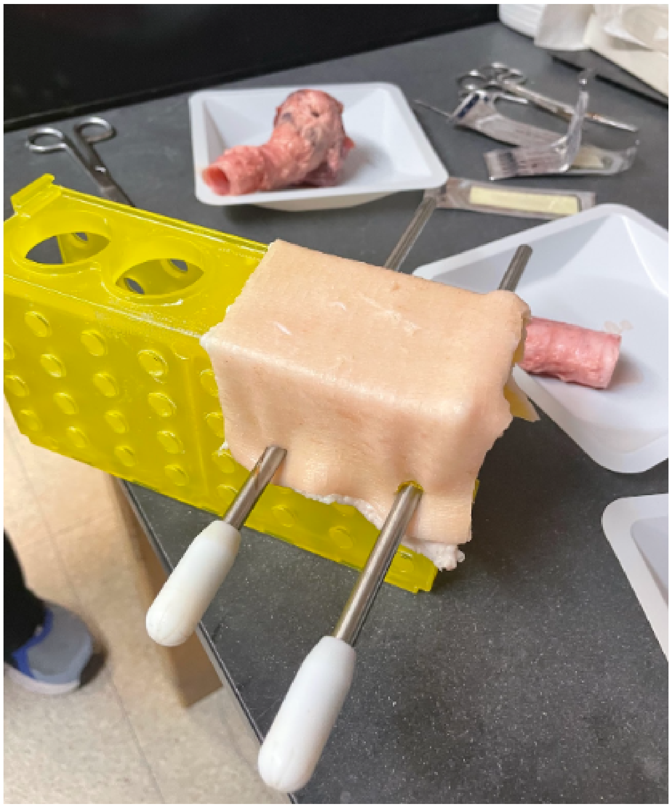


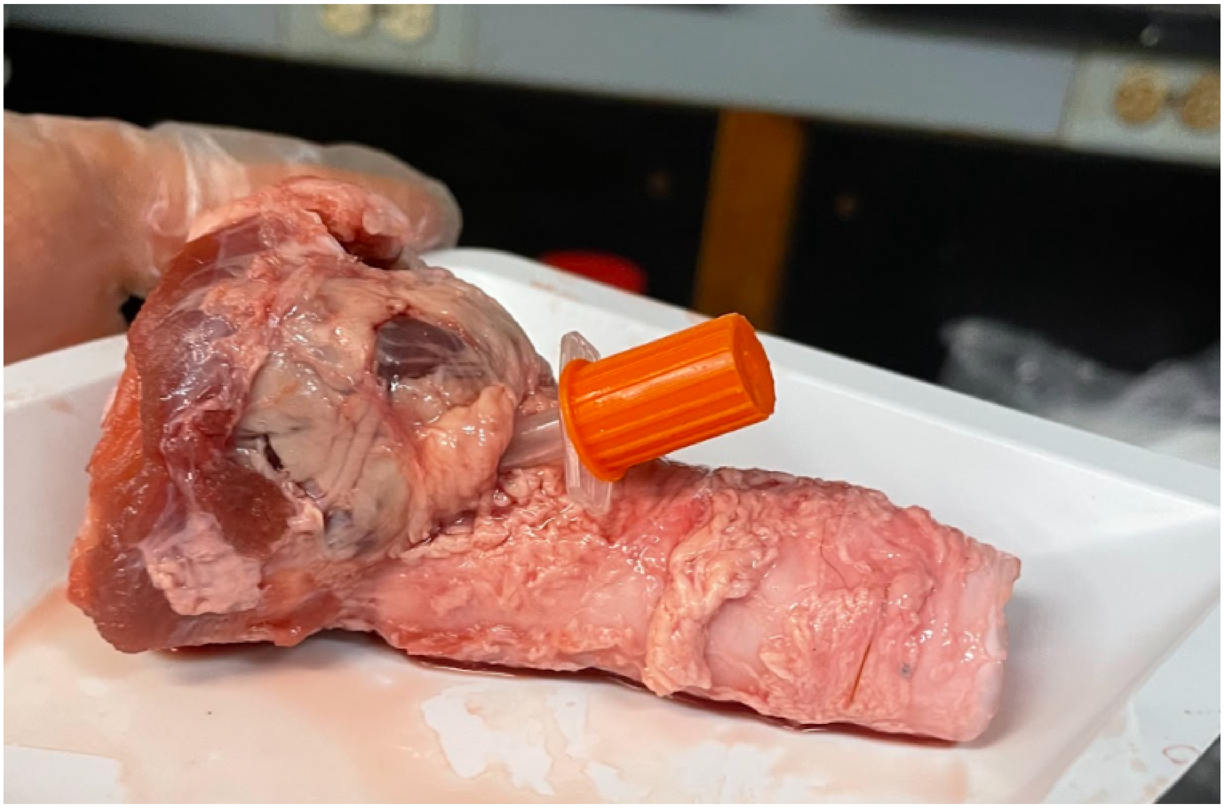
- Trachea:
  - None of us could puncture the trachea with the aluminum prototype
  - Kept slipping out of our hands

Plastic prototype:

- Could not achieve successful puncture on any of the samples

Client's prototype:

- Skin:
  - Successfully punctured the skin with less force than the aluminum prototype
- Trachea:
  - Could not puncture the trachea (difficult to stop the trachea from sliding out of our hands)
- Larynx:
  - Successfully punctured the cricothyroid membrane under less force than the team expected

- 

Conclusions/action items:

- The client's device was able to puncture the largest number of samples with the least amount of force
    - Has "wings" that the user can grip (a syringe)
    - Sharp tip concentrates force
- Our device does not work (not sharp enough)

Takeaways:

- Consider improving our design or making new designs moving forward.
    - Pointed tip, ergonomic grip
    - Could investigate new design using a manufactured needle
    - Couldn't fix the tissue correctly to achieve tension (design something to hold the samples)

3/3/2024 - 2/28 Testing

Megan Finell - Mar 03, 2024, 5:07 PM CST

Title: Additional Testing of the Sharpened Aluminum Device

Date: 3/3/2024

Content by: Megan

Present: Megan, Mateo, Kat, Zac

Goals: Evaluate if the device is now sharp enough to puncture tissue after using the belt sander to make a point.

Content:

During this testing, we only used the aluminum prototype.

- Puncture was achieved on the trachea and larynx
- First attempt success at puncturing the porcine trachea was 75% (3/4 people)
- Trachea
    - 
        - Everyone successfully punctured the trachea after two attempts
        - All participants applied grip pressure to the outer wall of the trachea with their left hand while successfully completing the procedure with the device in their right hand
            - The external pressure to the trachea minimized changes in the tracheal diameter and helped avoid slip
- Larynx
    - Only one person attempted to puncture the larynx (we only had one cricothyroid membrane)
        - The cricothyroid membrane was punctured after 3 attempts

- 
- During all attempts, the porcine larynx collapsed under the pressure of the aluminum prototype due to force applied while attempting pressure.
- The third attempt at puncture was completed successfully with the beveled edge facing up.

- Skin
  - Two people attempted to puncture the skin with the sharpened aluminum device
    - Failed to make a complete puncture
      - Probably due to lost mechanical qualities (such as elasticity) due to freezing/thawing

Conclusions/action items:

The device is now sharp enough to successfully puncture a porcine trachea and larynx. The next steps and further testing will require more porcine samples to be obtained. It is also necessary to design a testing setup that incorporates multiple tissues at one time.

5/1/2024 - 4/16 Testing

Megan Finell - May 01, 2024, 9:59 PM CDT

Title: Testing completed on 4/16/2024

Date: 5/1/2024

Content by: Megan Finell

Present: Megan, Mateo, Kat, Zac

Goals: Describe testing that was completed and document pictures

Content:

Important notes/features of this testing trial:

- This testing was completed after the prototype was sharpened
- This was the first testing completed with the testing fixation device
- This testing involved 5 larynges and 5 tracheas as well as thawed skin

Some testing was done with a handle on the prototype that was 3D printed. The handle didn't work perfectly and snapped under the pressure needed to puncture the tissue. Therefore, the team decided to not move forward with the handle.

Sharpened prototype:

The device was sharpened on the industrial sander in TEAM labs.

Testing fixation device images:

- The larynx or trachea were placed in the middle in a u-shaped cradle
- Skin was placed over the top to create tension and pull it taut
- This testing setup is meant to mimic human anatomy as close as possible
- Made out of sheet metal found in the TEAM lab

Tissue testing:

- Puncture tests were completed on the trachea, larynx, and skin
- The device was sharp enough to puncture all tissues, although it dulled over time because it is aluminum
- Tests were also completed on multiple tissues at the same time with the testing fixation device
  - These trials were also successful

Conclusions/action items:

Overall, this round of testing was very successful and validated the team's design. Moving forward, the team does not want to use the handle (it also broke). More pig skin needs to be bought before the next round of testing. The team wants to complete timing tests to further validate the device and ensure there are benefits to this design when compared to existing devices on the market.

5/1/2024 - 4/23 Testing

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Megan Finell - May 01, 2024, 10:40 PM CDT

Title: Timing Testing completed on 4/23/2024

Date: 5/1/2024

Content by: Megan Finell

Present: Megan, Mateo, Kat, Zac

Goals: Document the randomized timing tests that were completed by the team. The goal of these tests were to compare the time it takes to complete the procedure with our prototype vs the current surgical procedures.

Content:

Timing testing method:

- First, one of the team members was randomly chosen to complete the test (by a random generator)
- The other team members set up the station where the mock cricothyroidotomy would be performed with the prototype
    - They placed the larynx under the pig skin in the testing fixation device
    - The prototype was placed in a sealed bag to mimic unwrapping it from its sterile packaging
- The participant put on gloves, and the timer started when they turned around to assess the situation
    - The participant then unwrapped the prototype, palpated the cricothyroid membrane of the larynx (under the skin), and punctured the tissues
- Analysis was completed after the timer stopped
    - Evaluated if the device completely punctured the tissues
    - Pictures of the puncture on the cricothyroid membrane were used to analyze puncture measurements

Testing pictures:

Some tests were completed with a paper towel over the larynx to still ensure that the participant could not see the larynx and had to palpate for the cricothyroid membrane. They were done with the paper towel instead of pig skin because the pig skin was showing adverse qualities of thawing multiple times.

Results of 5 randomized trials between team members:

- Trial 1 (Megan): 11.39 seconds
- Trial 2 (Megan): 10.32 seconds
- Trial 3 (Zac): 12.79 seconds
- Trial 4 (Kat): 15.32 seconds
- Trial 5 (Kat): 15.49 seconds

Conclusions/action items:

Overall, results to the tests show that our device is almost 5 times faster than the current surgical procedure. This is very successful. Results could be skewed because all team members are familiar with the project and understand where the cricothyroid membrane is on a larynx.

2/16/2024 -- Neck Thickness

KATERINA SMEREKA - Feb 16, 2024, 9:55 AM CST

Title: How To Care For Your Neck

Date: 2/16/2024

Content by: Katerina

Present: N/A

Goals: Understand the thickness of the skin around the neck in order to properly design my idea of adding a case to our device

Content:

- skin chnages within the delicate tissue fo the neck
- changes due to age
- skin of the neck is thin
- dermis is thin
- skin of neck is comparable to eyelids---approximately 0.5-0.66mm
- platysma muscle, spread subcutaneouly from mandible to superior pectoralis and deltoid

Conclusions/action items:

This number will be very helpful in desiging the heights for my case that I want to design

2/29/2024--Journal of Anesthesia Details

KATERINA SMEREKA - Feb 29, 2024, 9:09 PM CST

Title: A dive into journal of Anesthesia

Date: 2/29/2024

Content by: Katerina

Present: N/A

Goals: Understand the requirements for Journal of Anesthesia

Content:

Overview:

- official journal of the Association of Anaesthetists
- includes aspects of general and regional anaesthesia, intensive care and pain therapy, including research on equipment
- welcome submissions or basic science papers if the authors can demonstrate their clinical relevance
- median time from submission to first decision is 12 days
- aims at consultant and and trainee practitioners involved in all branches of anaesthesia, intensive care medicine, pain therapy

Journal Metrics:

- 18.8 citescore
- 2023 full text views: 4105891
- 25% acceptance rate
- 21 days to acceptance

Current Edition Article Titles:

- Driving down the carbon cost of peri-operative care: old controversies, new topics, fresh perspectives and the futures
- Volatile capture technology in sustainable anaesthetic practice: a narrative review
- Clinical signs and examination during intubation: we will continue to use and teach them
- comparing performance of flexible bronchoscopy with videolaryngoscopy for awake tracheal intubation

Conclusions/action items:

Obviously, I am not aware of the current directions of anesthesiology research. So looking at the currrent article titles, I don't know how pressing most of the experiements are. However, I really felt confident that we could maybe get accepted because of the variety of the articles that they publish and how they are targeted to practioners, which could one day use our product.

2/29/2024--Journal of Anesthesiology Journal Information

KATERINA SMEREKA - Feb 29, 2024, 9:24 PM CST

Title: The details of Anesthesiology

Date: 2/29/2024

Content by: Katerina

Present: N/A

Goals: Understand the aims and scopes and see if we can publish in this journal

Content:

About the Journal:

Mission: Promoting scientific discovery and knowledge in perioperative, critical care, and pain medicine to advance patient care

Impact Factor: 8.8

Citation half-life: 12.1 years

- official journal of american society of anesthesiologists
- contains video abstracts, visual abstracts, infographics, interviews

Current Issue Article Titles:

- Variation in Hospital Neuraxial Labor Analgesia Rates in California
- Cognitive and cerebrospinal fluid Alzheimer's disease-related biomarker trajectories in older surgical patients and matched nonsurgical controls
- EEG biomakers from anesthesia induction to identify vulterable patients at risk for postoperative delerium
- Influence on FiO2 on lung perfusion distribution, regional ventilation, and lung volume during mechanical ventilation of supine healthy swine.

Conclusions/action items:

It was very suspect that there was not a page or a paragraph for their aims and scopes. Honestly, all of their articles were really jargon-y and ours won't be that technical to the degree that they exemplify. I don't think this will be our best option

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2/29/2024--Porcine Skin in Scientific Articles--1

KATERINA SMEREKA - Feb 29, 2024, 9:44 PM CST

Title: Tattoo Pigment Biokinetics in vivo in a 28-Day Porcine Model: Elements Undergo Fast Distribution to Lymph Nodes and Reach Steady State after 7 Days

Date: 2/29/2024

Content by: Katerina

Present: N/A

Goals: Underscore how scientific articles outline in the methods section about porcine skin for replicability

Content:

Introduction:

- "in this present study, we used porcine skin, which has been demonstrated to closely resemble human skin. Since porcine skin shows major anatomical site variation, we concentrated on teh skin of the inner thigh of the pig, which shows the closed similarity to human skin in thickness as well as texture. In this prospective study, we investigated the biokinetics of tatto ink pigments over 28 days post-tattooing to measure..."

Methods:

- Animals
  - protocls approved by austrain federal ministrity of education, science and research
  - four female pigs were used in this study (gane age, weight avg + sd)
  - talked about housing conditions
- Schedule
  - The trial began at X date
  - on day 1, shaving and tattooing were performed
  - "After sacrificing the animals on day 28, regional lymphadenectomy was performed and the internal organs of interest were removed. The detailed procedure of anesthesia, euthanasia, tattooing can be found in the online supplementary materials"

Conclusions/action items:

What is very interesting is how detailed they gave their protocol, but it seemed liked they housed and took care of the animals, which is not the case for us. However, it is good to know that we should have a clause about an IACUC or IRB office or something like that

2/29/2024--Porcine Skin in Scientific Articles--2

KATERINA SMEREKA - Feb 29, 2024, 9:48 PM CST

Title: The Association of Oleic Acid and Dexamethasone Acetate into Nanocapsules Enables a Reduction in the Effective Corticosteroid Dose in a UVB Radiation-Induced Sunburn Model in Mice

Date: 2/29/2024

Content by: Katerina

Present: N/A

Goals: Underscore how scientific articles outline in the methods section about porcine skin for replicability

Content:

Methods:

- "The DEX skin permeation from the hydrogels was assessed by empploying the porcine skin tissue obtained from a local slaughterhouse (Santa Maria, Brazil). The skin was cleaned... Franz diffusion cells were employed for this evaluation."

Conclusions/action items:

I think I could use this. I didn't know if there was a standard article that people cite for porcine skin protocols. But that is good that you can be transparent that you purchased porcine skin for testing

4/21/2024- Evaluating novel cricothyroidotomy introducer

KATERINA SMEREKA - Apr 21, 2024, 5:46 PM CDT

Title: Evaluation of a novel cricothyroidotomy introducer in a simulated obese porcine model: a randomised crossover comparison with scalpel cricothyroidotomy

Date: April 21, 2024

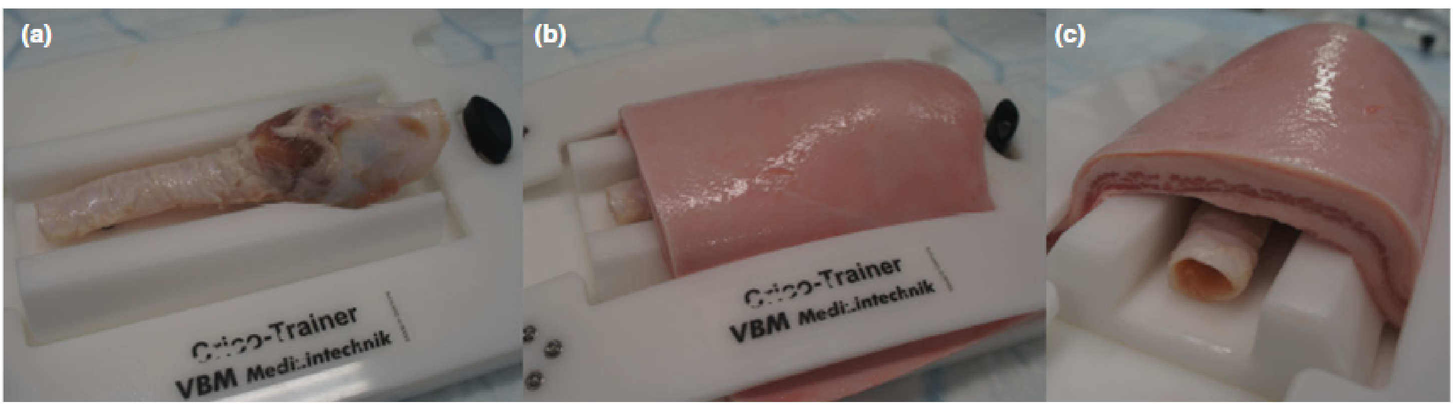
Content by: Katerina

Present: N/A

Goals: Understand how the literature defines more 'realistic' testing and how timing trials are conducted

Content:

- novel cricothyroidotomy introducer was created
- going to be timed against a traditional cricothyroidotomy
- randomised crossover study
- simulated obese porcine larynges
- recruited anesthetists
- participants were given an info sheet, pre study questionare
- subjects watched videos demonstrated the two techniques
- subjects had an opportunity to pratice on a plastaic model
- asked to perform the two techniques in a randomised method
- start point: handling the equipment
- final point: successful ventilation with BVM bag
- folloq up questionare



Conclusions/action items:

This is very helpful in understanding where timing should begin for our data. I think it would be a good idea to bag the device to simulate taking it out of a sterile package and start the timer when the person reaches for the bag to open.

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4/21/2024- Evaluating novel cricothyroidotomy--bench top model

KATERINA SMEREKA - Apr 21, 2024, 5:53 PM CDT

Title: Evaluation of a novel emergency front of neck access device in a benchtop model of obesity

Date: 4/21/2024

Content by: Katerina

Present: N/A

Goals: Understand what other research has done to create more ideal emergency situations and how they time their testing

Content:

- 7 participants
- 5 residents, 2 attendings
- training took place 1 week before data collection
- training
  - formally instructed on how to use the device
  - got unlimited practice
- data collection
  - subject performed each technique four times in each model
- criteria was if the procedure was performed in 40 seconds or less

Conclusions/action items:

This paper is less helpful because they loosely defined their testing methods to see if each procedure could be completed within 40 seconds. While this is a good criteria, they never defend their decision of 40 seconds and what that time period represents or why 40 seconds were selected, so not much information to gather from this.

2/16/2024 -- Design 1: The Wine Opener

KATERINA SMEREKA - Feb 16, 2024, 9:43 AM CST

Title: The Wine Opener

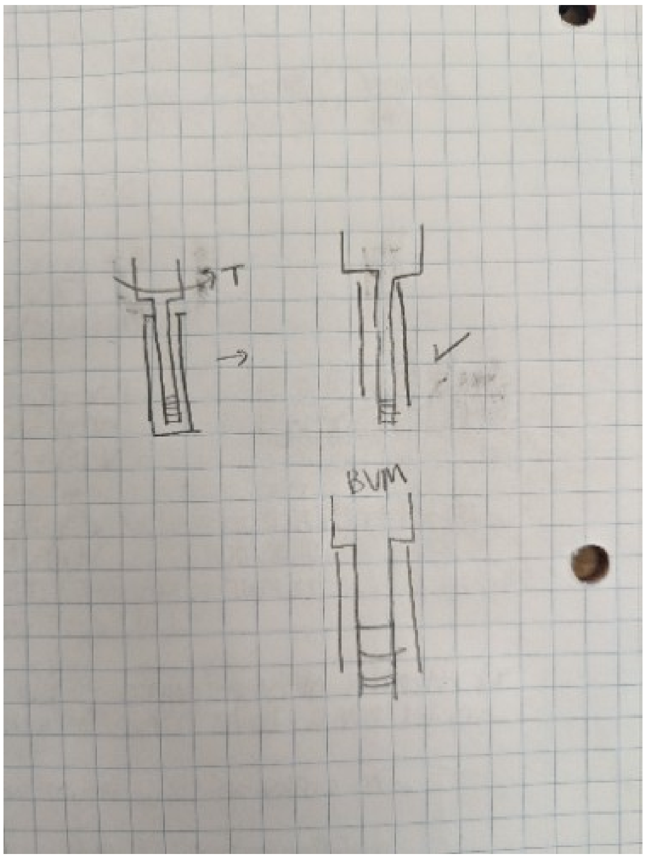
Date: 2/16/2024

Content by: Katerina

Present: N/A

Goals: Create a better design that is sharper and more ergonomic

Content:



I don't know why it poorly uploaded, but basically my idea is a new version in which this relies on a torque. Basically, there is a hollow inner tube that has jagged edges on the distal end (like a screw) that is super sharp. The top is made to fit a BVM and the casing is wider than the inner tube but not as wide as the BVM handle. The user will apply a torque to create the airway and the handle gets stopped by the tube when it makes the depth that it needs.

The one thing is that I still don't know how to properly fix the device to the patient for a more accurate puncture.

Conclusions/action items:

ACTION: present idea to the team

2/16/2024 -- Design 2: An addition to the current model

KATERINA SMEREKA - Feb 16, 2024, 9:51 AM CST

Title: But Wait! There's More!

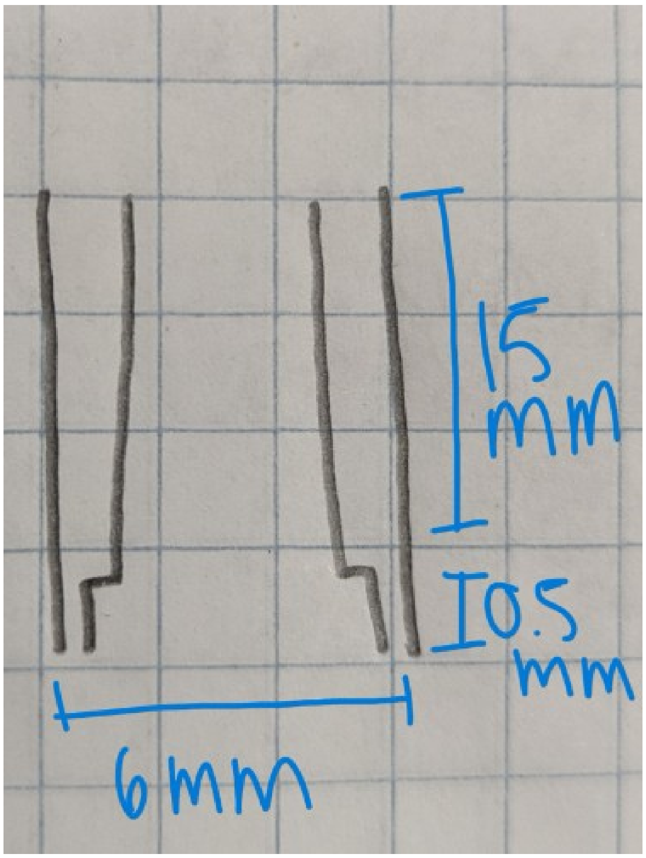
Date: 2/16/2024

Content by: Katerina

Present: N/A

Goals: Create a better design that is sharper and more ergonomic

Content:



Again, I think one thing our device lacks is the ability to be stable and get a clean puncture. Especially in an emergency situation, people's hands are shaking and not get a accurate puncture. So I think we could use this casing thing to ADD to our device. At the bottome would be something like a lancet-esque that can punture through the skin. It would go around the shank of our device so that it would be easy to use the palm of your hand to push in our device.

Conclusions/action items:

ACTION: present idea to the team

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4/12/2024--Preparation for Testing

KATERINA SMEREKA - Apr 12, 2024, 12:28 PM CDT

Title: Transcript for Preparation of Testing

Date: April 12, 2024

Content by: Katerina S

Present: N/A

Goals: Outline how to set up testing

Content:

- the porcine larynges came to the lab as just tissues in bags

- thaw larynges for 1 hour in water bath

- the larynges should be semi-thawed

- submerge tissue in 0.9% saline

- thaw larynges again for another 30 minutes

- remove larynges and pat to dry off

- remove exccess accessory tissue on posterior side of tissue

- trim trachea so that it extends 2 inches past larynx

Conclusions/action items:

feeling so good about testing

2024/2/4 - Possible Journals to Publish in

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Mateo Silver - Feb 04, 2024, 3:20

Title: Possible Journals to Publish in

Date: 2/4/2024

Content by: Mateo

Present: n/a

Goals: Look into what journals other BME teams and similar projects have published in.

Content:

Previous BME 400 teams have published in a variety of discipline specific journals, including:

Project	Journal	Impact Factor (in publication year)	DOI
Lateral flow card for Point-of-Care COVID-19 antibody testing	Biomedical Optics Express	3.4	10.1364/BOE.454919
Microfluidic Device to Competitively Measure Biofilm Dispersion Potential	Science Advances	14.1	10.1126/sciadv.aay991
Evaluation of LN2 Dewar Health Using a Weight-based Monitoring System	Reproductive BioMedicine Online	3.2	10.1016/j.rbmo.2019.07
Mask for Oral Anesthesia and Manipulation	Viruses	5.0	10.3390/v12040450
A miniature microscope for fluorescence imaging	The Biophysicist	1.0	10.35459/tbp.2019.000
Surgical centrifuge that saves blood	Journal of Medical Engineering & Technology	0.379	10.1080/03091902.201
Automated System for Rat Gavage	Applied Ergonomics	2.4	10.1016/j.apergo.2016.
Lipoma extraction device	Clinical Dermatology	n/a	10.11138/cderm/2015.3
Standardization of hapten delivery in the diagnosis of allergic contact dermatitis	Dermatitis	2.4	10.1097/DER.0000000
Absorbable hydrodissection fluids	Journal of Biomedical Materials Research Part B: Applied Biomaterials	2.3	10.1002/jbm.b.32959

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Identifying the journals that other BME design teams have published in is a good way of identifying the tier of journal we should be applying to. All these journals are very discipline specific, so it that we will choose one of these in particular, but it is helpful to get an idea about the type of journals we can apply to.

Next, here are a few of the journals that have featured similar medical device or topics as our prototype:

Device Tested	Purpose of study	Tested on	Journal	Impact Factor (in publication year)	DOI
Cric-Guide	Comparing outcome of novel (scalpel based) device to traditional cric technique (also using scalpel)	excised porcine trachea with larynx, with porcine backfat tissue and porcine skin laid on top. Entire model placed in VBM Crico Trainer. n=56 tested on each method	Irish Journal of Medical Science	1.224	10.1007/s11845-0 5
Surgicric	Comparing speed of novel (cannula based) device to scalpel based and cannula based techniques	excised porcine trachea with larynx, with artificial skin laid on top. Entire model placed in VBM Crico Trainer. n=25 tested on each method	Anaesthesia	10.7	10.1111/anae.132
PYNG CRIC device	Comparing speed and complications of novel (scalpel based device) to traditional surgical technique (also using scalpel)	TraumaMan manikin model, in different combat related scenarios (emergency room, daytime and nighttime combat simulations). n=60 tested on each method	Military Medicine	0.948	10.7205/MILMED- 00266
Reactor device	Comparison of chest tube placement device with traditional technique	Live porcine model n=23?	The American Journal of Emergency Medicine	4.1	10.1016/j.ajem.20

Many similar medical devices, for cricothyroidotomy and other emergency medicine procedures have been tested on animal models such as the one we have tested on. The sample size used is per method tested. There is a wide variety in the journals that have been published in.

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Finally, I investigated a few journals that seemed to be in alignment with our topic:

Journal	Impact Factor	Topics covered	Good fit for our project?	Link
Journal of Medical Devices	0.9	"Of interest are devices of all scales from quantum to nano, micro, and **macro**; and for all biomedical applications including experimental, diagnostic, therapeutic, and **interventional usages**. The journal is particularly interested in multidisciplinary research integrating engineering with other fields (materials, medicine, biology, physics, computer science, chemistry, and more)."	Recent journal articles seem don't involve medical devices or emergency medicine.	https://journaltool.asme.org/home/JournalDescriptions.cfm?JournalID=22
Anaesthesia	5.7	"general and regional anaesthesia, intensive care and pain therapy, including **research on equipment**. Although **primarily a clinical journal**, we welcome submissions or basic science papers if the authors can demonstrate their clinical relevance."	Not many devices regarding interventional or emergency devices. Most device related articles are for anesthesia delivery or clinical use.	https://associationofanaesthetists-publications.onlinelibrary.wiley.com/hub/journal/13652044/homepage/productinformat
Journal of Emergency Medicine	1.5	"research papers and clinical studies as well as articles focusing on the training of emergency physicians and on the **practice of emergency medicine**"	Have published papers about cricothyroidotomy procedure before, but mostly regarding education and outcomes, not new devices	https://www.jem-journal.com/content/aims

Conclusions/action items:

This information will be used in our preliminary presentation as we identify a possible journal to present our manuscript to.

2024/3/12 - Annals of Emergency Medicine

Mateo Silver - Mar 12, 2024, 11:18 PM CDT

Title: Annals of Emergency Medicine

Date: 3/12/2024

Content by: Mateo

Present: n/a

Goals: Look into the types of manuscripts accepted and their requirements

Content:

- After realizing that the journal *Anesthesia* was not a good fit for our manuscript, we pivoted towards *Annals of Emergency Medicine*

- This is an open access journal published by the American College of Emergency Physicians, with an impact factor of 6.6

- Its' aims and scopes include: emergency medicine and airway management, making it a good fit for our project

- Recent publications include, airway management techniques, cricothyroidotomy procedure techniques

- ASME journals accept 3 types of technical manuscripts: Original Research, Brief Research Reports, and Research Letters

- A brief report would probably be the best fit for our manuscript, it encompasses preliminary data and requires a short er report

- Maximum 1750 words, 250 word abstract, 15 references, 4 tables/figures

- In the past, articles have been published comparing different cricothyroidotomy techniques [1]

- The journal has also published articles on novel medical devices in the past, although these tend to be abstracts submitted for conferences not full original research papers

- We have reformatted our preliminary manuscript to match the requirements of *Annals of Emergency Medicine*

References:

[1] https://pubmed.ncbi.nlm.nih.gov/24094476/

Conclusions/Action Items:

Get feedback on preliminary manuscript and revise.

2024/4/11 - WARF Next Steps

Mateo Silver - Apr 11, 2024, 11:37 PM CDT

Title: WARF Next Steps

Date: 4/11/2024

Content by: Mateo

Present: n/a

Goals: Determine what the process is for WARF disclosures.

Content:

- Since submitting our initial idea disclosure, we quickly heard back from WARF to schedule a meeting to discuss our idea

- Next week we will meet with an IP manager for a disclosure meeting, where we will give more information to WARF about our design and its usage

- In a few weeks, at their monthly meeting, WARF's internal decision committee will discuss the originality of the idea as well as the economic benefit to WARF.

- If the proposal continues, it will undergo an equity review to identify any other groups which may be entitled to IP

- Finally, the team would enter a legal agreement with WARF, where we agree to sell our IP in exchange for royalties on the patent.

- A few weeks later, we would work with the patent lawyers and experts at WARF to prepare and file a patent. It can take multiple years for a patent to successfully be approved.

Conclusion/Action Items:

Meet with WARF next week.

2024/2/15 - Airflow Testing

Mateo Silver - Feb 15, 2024, 9:11 PM CST

Title: Airflow Testing

Date: 2/15/2024

Content by: Mateo

Present: n/a

Goals: Research methods of testing airflow through device.

Content:

- One of our major device requirements is that it should be able to move 500mL of air every 3 seconds.

- Testing that our prototype meets this requirement is one of our goals for this semester, as we did not have time to test this in the fall.

Anemometer:

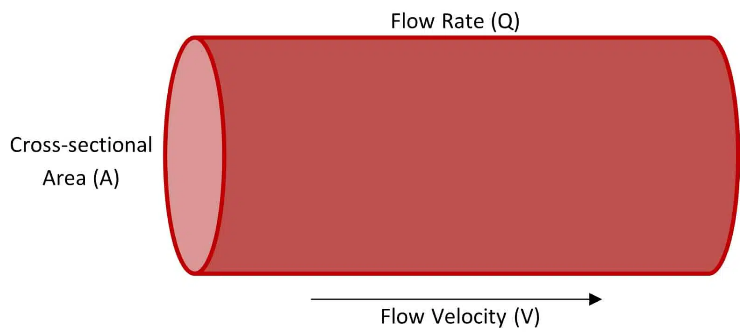
- An anemometer is a device used to measure the speed of wind

- By blowing through our prototype, into an anemometer, we could calculate the velocity of air coming out of the device

- The following equation can be used to convert the velocity to flow rate. For example, a flow velocity of 3m/s and cross-sectional area of of 1 cm^2 results in a flow rate of 300mL/s

volumetric Flow Rate (Q) = Flow Velocity (V) × Cross-sectional Area (A)

- The anemometer shown below is available for only $14, which



[1]

[2]

Syringe:

- A method of testing airflow that Megan suggested was attaching a syringe of known volume to our prototype.

- We would depress the plunger on the syringe, and time how long it takes to displace all the air.

- For example, we could use a 500mL syringe, and see if it takes 3 seconds or less to depress the plunger

- This 500mL syringe below is $13, including tubing. Using a syringe for testing would be an economical method of ensure we meet our client's requirements.

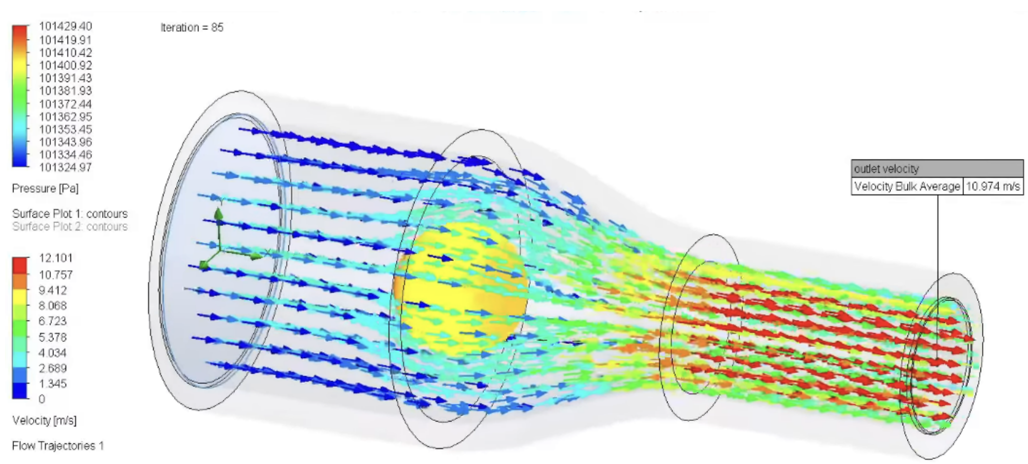
[3]

Solidworks

- Finally, another method for testing flow rate is by using Solidworks to simulate the flow of air.

- For this test, we could apply a air pressure equivalent to that which the user's lungs can generate

    - This simulation would result in flow volume delivered to the patient.



[4]

References:

[1] https://esenssys.com/air-velocity-flow-rate-measurement/

[2] https://www.amazon.com/Clatoon-Anemometer-Handheld-Temperature-Meteorology/dp/B0B7NB6RFH/

[3] Conclusions/action items:

Create testing protocol, test current prototype.

2024/4/11 - Testing Fixation Device

Mateo Silver - Apr 11, 2024, 11:16 PM CDT

Title: Testing Fixation Device

Date: 4/11/2024

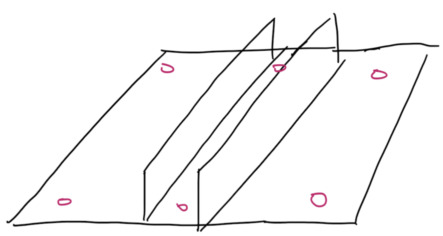
Content by: Mateo

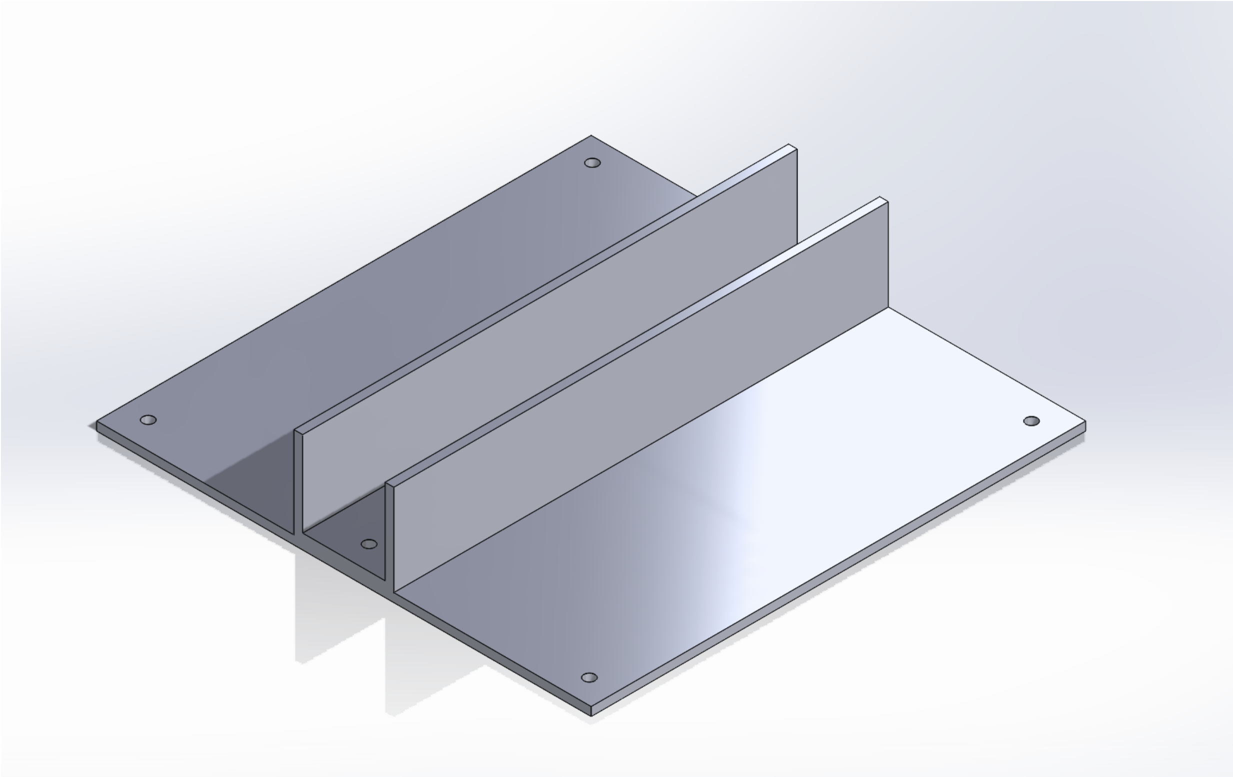
Present: n/a

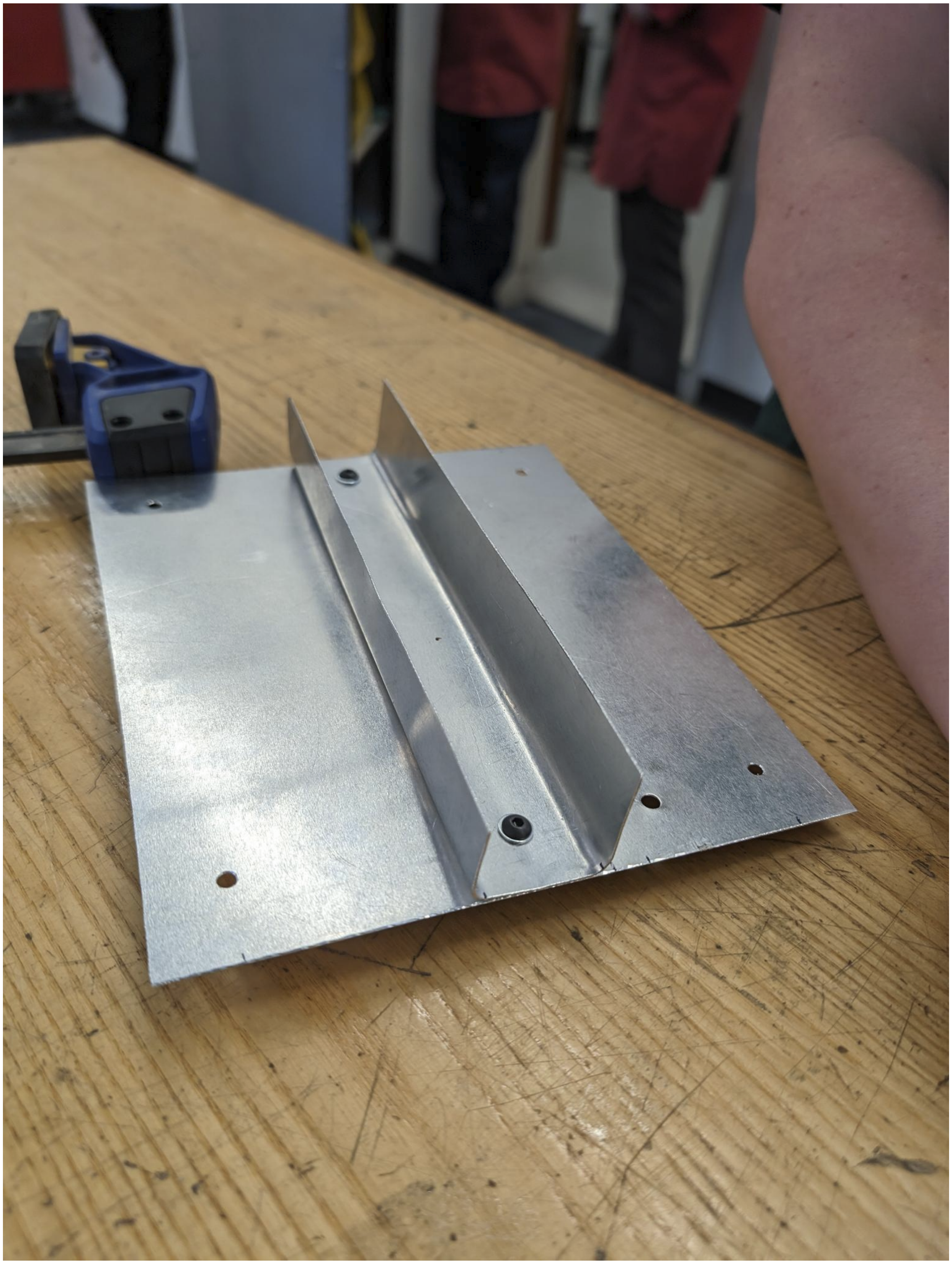
Goals: Create device for proper fixation

Content:

As the team moves into larger scale final testing, a need for consistent tissue fixation has been created. A simple design was created consisting of an aluminum channel mounted to a sheet of aluminum. 1/8 inch aluminum sheeting was used, with M4 bolts and nuts used to secure the design together. The four bolt holes at the edges allow for the porcine skin to be affixed during testing. This design allows for the trachea to be placed in the channel and resist movement while being compressed.







Conclusion/Action Items:

Utilize this new testing device while testing tomorrow.

2024/4/11 - Testing Fixation Device Usage

Mateo Silver - Apr 12, 2024, 10:18 AM CDT

Title: Testing Fixation Device

Date: 4/11/2024

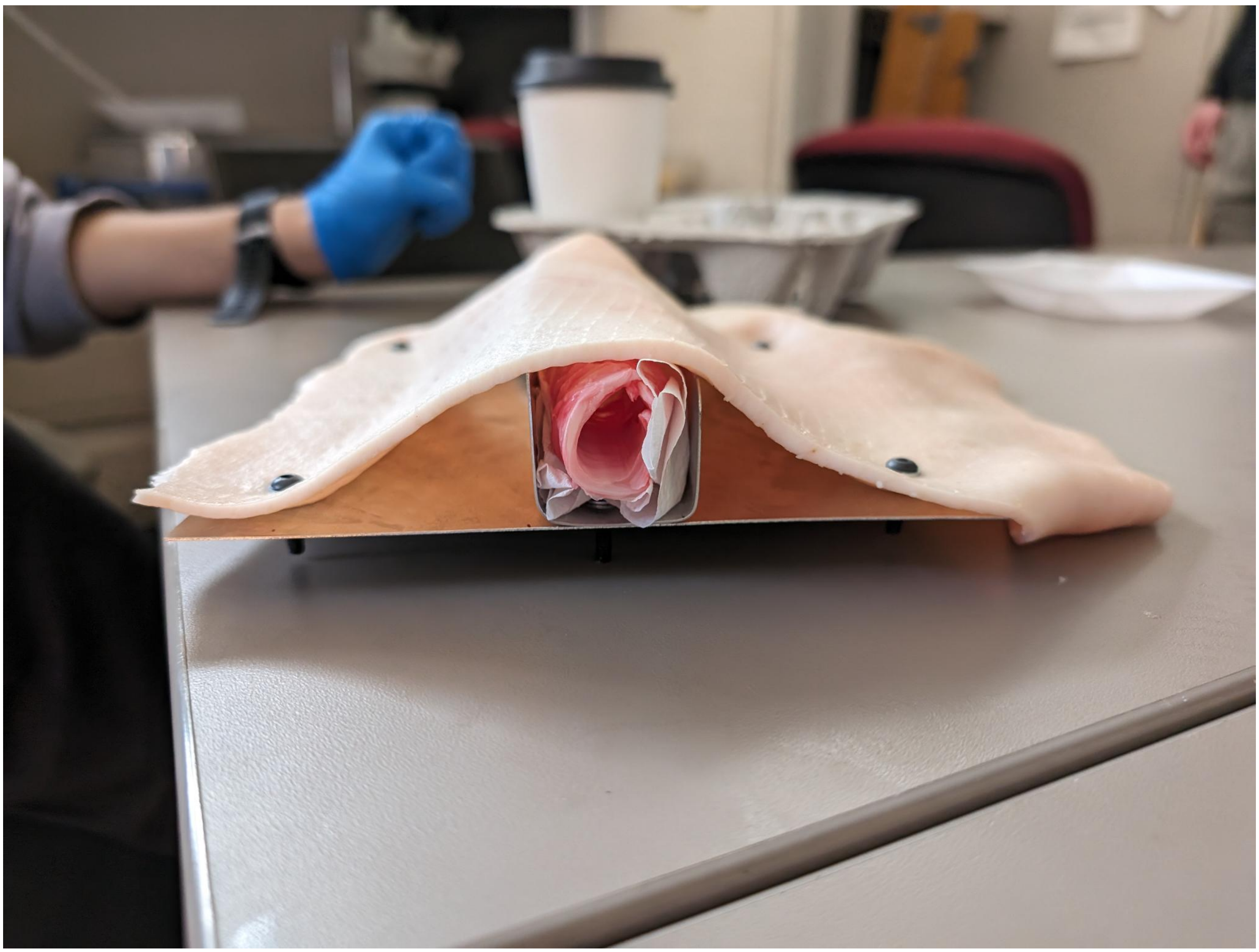
Content by: Mateo

Present: n/a

Goals: Evaluate how the testing fixation device was used during testing.

Content:

During testing, the device was successful in fixating the trachea and skin. It helped with making the testing setup more consistent between trials, and between users. paper towels were added to the sides of the channel to ensure a snug fit of the trachea.



Conclusion/Action Items:

Iterate on the design for future work.

2024/3/12 - Possible Outreach Activities

Mateo Silver - Mar 12, 2024, 11:21 PM CDT

Title: Possible Outreach Activities

Date: 3/12/2024

Content by: Mateo

Present: n/a

Goals: Research activities we can use for our outreach presentation

Content:

- During our last team meeting, we discussed what our objectives were for our outreach presentation

- We decided that we wanted to find an activity that paralleled the iterative design process that we went through in designing our device

- At first we thought about doing an egg-drop type activity, but thought it might be too messy and not very relevant

- To bring more of a BME focus to the presentation, we decided to create a design challenge involving fixating a broken bone

- We used a few activity guides from online to draw inspiration and narrow down our idea

Engineering a Better Cast [1]:

- This is a longer term project suitable for a classroom

- It encourages students to find specific issues with current casts, and improve that aspect of the design

- We could use this is a point of discussion during the initial brainstorming portion of our activity

- It also includes a list of possible materials students could use in their design

    - for example: cardboard, duct tape, rubber bands, zip ties, etc.

- We may choose a few of these materials which lend themselves well to the limited time frame of our activity

Repairing Broken Bones [2]

- This activity uses real turkey femurs, to create a more challenging structure
- Instead of designing a cast, students are asked to create an internal fixation device, such as bone screws
- This project inspired us to use realistic bone anatomy, as opposed to a dowel or cylindrical shape
    - Doing this makes the fixation more challenging and realistic.

References:

[1] https://www.teachengineering.org/activities/view/upitt-2621-engineering-better-cast-design-activity

[2] https://www.teachengineering.org/activities/view/cub_biomed_lesson10_activity1

Conclusions/Action Items:

Finish developing outreach plan by creating presentation and activity guide.

2024/3/12 - Bone model for outreach activity

Mateo Silver - Mar 12, 2024, 10:35 PM CDT

Title: Bone model for outreach activity

Date: 3/12/2024

Content by: Mateo

Present: n/a

Goals: Create/find bone model to 3D print for outreach activity.

Content:

- As discussed in the previous entry, we have decided to use a 3D printed bone model for students to design a cast for

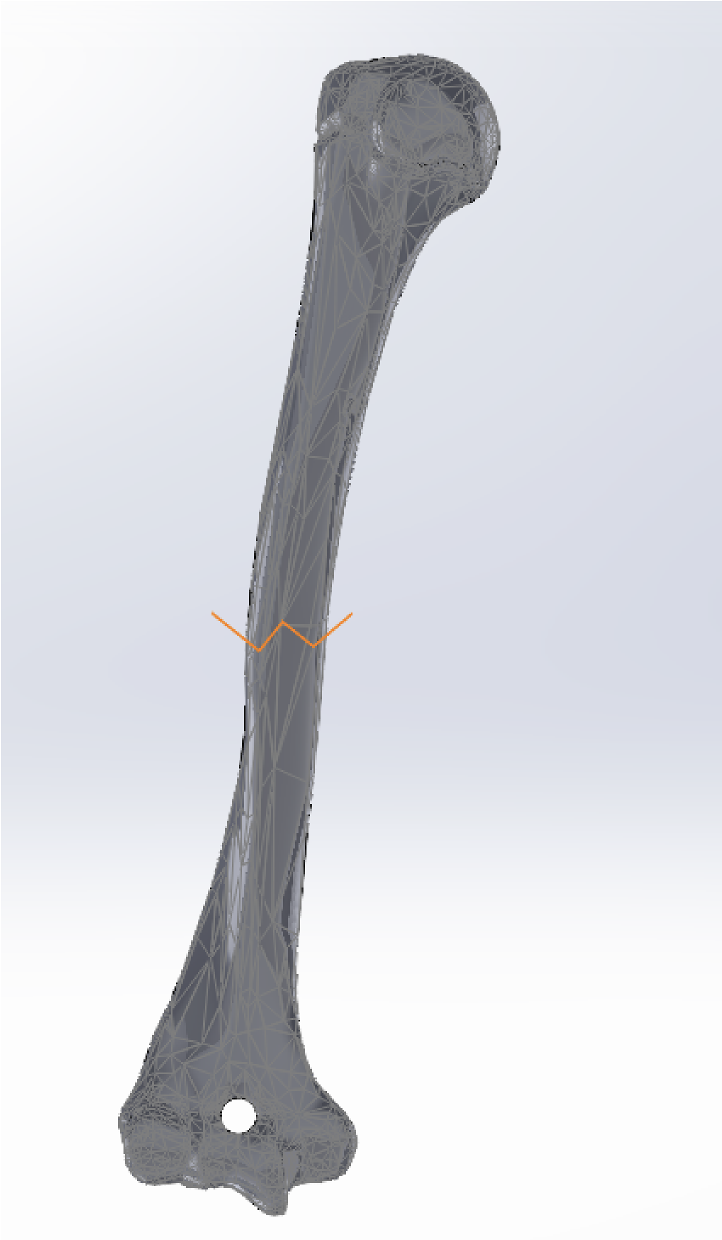
- This model must be realistic in size and structure, and have a fracture along the length of the bone

- I found a 3D model on thingiverse [1], which I was able to bring into solidworks to create a fracture

- Although not the most common type of fracture, a break halfway down the bone will be the easiest to fixate

- Along with creating the break, the distal end of the bone must be modified to allow a weight to hang on it

- Once these changes had been made, the model was ready for 3D printing.



References:

[1] https://www.thingiverse.com/thing:367268

Conclusions/Action Items:

Test 3D print this week, make necessary changes and print in bulk next week.

2024/4/20 - Intended device location/usage

Mateo Silver - Apr 21, 2024, 6:57 PM CDT

Title: Intended device location/usage

Date: 4/20/2024

Content by: Mateo

Present: n/a

Goals: Understand where the device will be used and how quickly it can be accessed.

Content:

- Our client has previously stated that he envisions this product openly available to the public, in the same way emergency devices like an AED are

- Current state legislation outlines locations which should have an AED available. These are all areas that have a high risk of a cardiac event occurring, for example sports facilities, areas where large groups of people will congregate, etc. [1]

- Another common guideline for device placement is to be accessible within 3 minutes of an emergency situation [2]. This means that multiple AEDs may be needed in the same building or floor of a building.

- Our product has a higher likelihood of being needed in these same situations, which is why it could be placed in the same locations

- In addition, our product could be placed in areas where the risk of choking may be higher, for example in sports stadiums or dining halls.

References:

[1] https://policy.wisc.edu/library/UW-6064

[2] https://www.aeduniverse.com/AED_Placement_s/17.htm.

Conclusions/action items:

Include this information in future work of poster.

2024/4/21 - Device sterility

Mateo Silver - Apr 21, 2024, 7:20 PM CDT

Title: Device sterility

Date: 4/21/2024

Content by: Mateo

Present: n/a

Goals: Explore possible options for sterilizing/packaging device

Content:

- Common techniques for sterilization of medical devices include: ethylene oxide, autoclaving, heating, vaporized hydrogen peroxide, and radiation.

- The chosen method of sterilization must maintain material properties and functionality of the device

- Up to 50% of current FDA approved devices are sterilized using ethylene oxide

- Certain polymers may absorb EtO gas, which contraindicates its use. In this case, radiation may be used to sterilize the device. [2]

- Because our device is made of a metal which is stable at high heat, steam sterilization using an autoclave should be an acceptable method of ensuring sterility.

- Specifically, to be used with steam sterilization, a material should withstand up to 121°C and be resistant to a humid environment.

- If our device was made of a heat-sensitive material, like a polymer or low-melting-temperature metal, EtO gas could be a potential option.

- To package the device and maintain sterility, a sterilization pouch is used. This pouch allows for the device contained inside to be cleaned, while staying sealed to the outside environment. [3]

- For sterilization in an autoclave, a paper/plastic pouch is commonly used. It is permeable to the steam, and becomes air-tight after autoclaving. [4]

References:

[1] https://www.fda.gov/medical-devices/general-hospital-devices-and-supplies/sterilization-medical-devices

[2] https://ethidelabs.com/which-is-the-best-sterilization-method-for-your-medical-device/

[3] https://www.steris.com/healthcare/knowledge-center/sterile-processing/guide-to-sterilization-pouches-in-sterile-processing

[4] https://medicom.com/en_ca/blog/its-a-wrap-everything-you-need-to-know-about-sterilization-pouches/

Conclusions/action items:

Include this information in the future work section of the final poster.

2024/4/21 - Mass manufacturing

Mateo Silver - Apr 21, 2024, 7:44 PM CDT

Title: Mass manufacturing

Date: 4/21/2024

Content by: Mateo

Present: n/a

Goals: Understand cost of mass manufacturing of our product

Content:

- Assuming we manufacture out of 304 Stainless steel (commonly used for medical devices), using the stock price on McMaster-Carr, the price of raw materials should be approx. $3.655 per unit. [1]

- The hourly cost of using a CNC machine can be as low as $50/hr [2]

- With automated tooling, it may only take minutes to produce one part

- On top of these costs are the overhead of establishing a relationship with a manufacturer, programming toolpaths, and initial production.

- Overall, we could expect a unit cost on the scale of tens of dollars to be a reasonable estimate

References:

[1] https://www.mcmaster.com/4011N24/

[2] https://deburringtechnologies.com/job-costing-for-cnc-machining-centers-challenges-and-opportunities/

Conclusions/action items:

Include this information in the future work section of the final poster.

2024/2/14 - Implementing a manufactured needle - Luer Lock

Mateo Silver - Feb 15, 2024, 9:58 PM CST

Title: Implementing a manufactured needle - Luer Lock

Date: 2/14/2024

Content by: Mateo

Present: n/a

Goals: Investigate using a manufactured needle in our design

Content:

Background:

- During preliminary testing, our device was not sharp enough to puncture porcine skin

- A possible idea we had was to manufacture the body of our prototype ourselves, but attach it to a pre-manufactured needle

- This has the added benefit of maintaining sterility by using a new needle every time the product is used

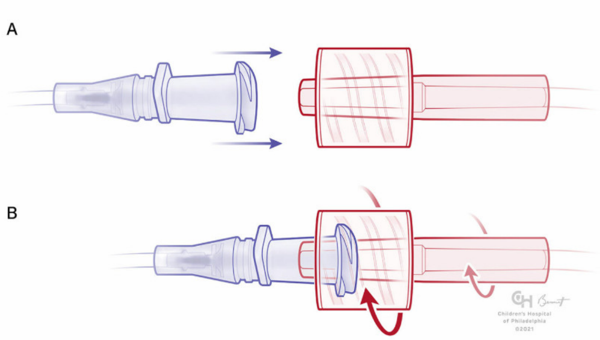
- Additionally, we can be confident that the needle will be sharp and able to puncture through the skin and cricothyroid membrane

Luer Lock Syringes:

- A common connection method for medical syringes is called the Luer Lock system (1)

- This creates a secure, airtight, connection between the syringe and needle

- We could incorporate the female portion of the device into our design, and attach a purchased needle to it.



- Luer lock syringes come in gauges ranging from 0000G to to 34G, representing the nominal outer diameter

- Comparing a gauge chart (2,3) to our current prototype, a size 7G needle would have a similar inner diameter

    - Prototype ID: 0.1575 inches (4 mm)

    - 7G Needle ID: 0.150 ±0.003 inches (3.810 mm ±76 μm)

Gauge,	Nominal outer diameter		Nominal inner diameter		Nominal wall thickness	
G	(inch)	(mm)	(inch)	(mm)	(inch)	(mm)
6	0.203 ± 0.001	5.156 ± 0.025	0.173 ± 0.003	4.390 ± 0.076	0.015 ± 0.001	0.381 ± 0.025
7	0.180 ± 0.001	4.572 ± 0.025	0.150 ± 0.003	3.810 ± 0.076	0.015 ± 0.001	0.381 ± 0.025
8	0.165 ± 0.001	4.191 ± 0.025	0.135 ± 0.003	3.429 ± 0.076	0.015 ± 0.001	0.381 ± 0.025
9	0.148 ± 0.001	3.759 ± 0.025	0.118 ± 0.003	2.997 ± 0.076	0.015 ± 0.001	0.381 ± 0.025
10	0.134 ± 0.001	3.404 ± 0.025	0.106 ± 0.003	2.692 ± 0.076	0.014 ± 0.001	0.356 ± 0.025
11	0.120 ± 0.001	3.048 ± 0.025	0.094 ± 0.003	2.388 ± 0.076	0.013 ± 0.001	0.330 ± 0.025
12	0.109 ± 0.001	2.769 ± 0.025	0.085 ± 0.003	2.159 ± 0.076	0.012 ± 0.001	0.305 ± 0.025

- Another design challenge is

Implementing Luer Lock Syringes into design:

- Manufacturing a female luer lock connection will be the greatest challenge of this approach

- It would be very challenging to create the complex geometry of a luer lock in aluminum, or another metal

    - To avoid this, we could create a simple threaded portion of the device, then use an adaptor to interface with the luer lock

    - This introduced a new problem of limiting the fluid flow rate through this tight connection. Additionally, a smaller hole may require more pressure to breathe through.

- One alternative would be 3D printing the body of the device, but 3D prints are difficult to sterilize

- Of the 3D printing materials available at the makerspace (4), none are able to be autoclaved

Plastics Sterilization Compatibility Chart

Polymer	Polymer Abbreviation	Autoclave	Dry Heat	Ethylene Oxide (EtO)	Gamma Irradiation	Electron Beam
Biopolymers						
Polycaprolactone	PCL	Fair	Good	Good	Good	Good
Polyglycolic acid	PGA	Good	Good	Good	Good	Good
Polyhydroxybutyrate	PHB	Poor	Poor	Good	Fair	Fair
Poly(L-lactide)	PLLA	Fair	Good	Good	Good	Good
Poly(lactic-co-glycolic acid)	PLGA	Poor	Poor	Good	Fair	Fair
Polylactic acid	PLA	Poor	Fair	Good	Good	Good
Elastomers						
Copolyester thermoplastic elastomer	TPC	Poor	Good	Good	Good	Good
Ethylene propylene (diene-) terpolymer	EPDM	Good	Good	Good	Good	Good
Olefinic thermoplastic elastomer	TPO	Poor	Fair	Good	Good	Good
Polyamide thermoplastic elastomer	TPA	Poor	Poor	Good	Good	Good
Silicones		Good	Good	Good	Good	Good
Styrenic thermoplastic elastomer	TPS	Poor	Poor	Good	Good	Good
Urethane thermoplastic elastomer	TPU	Poor	Fair	Good	Good	Good
Fluropolymers						
Chlorotrifluoroethylenevinylidene fluoride	FKM / FPM	Poor	Good	Poor	Poor	Poor
Ethylene chlorotrifluoroethylene	ECTFE	Good	Good	Good	Good	Good
Ethylene tetrafluoroethylene	ETFE	Good	Good	Good	Good	Good
Fluorinated ethylene propylene	FEP	Good	Good	Good	Fair	Fair
Perfluoro alkoxy	PFA	Good	Good	Good	Good	Good
Polytetrafluoroethylene[1]	PTFE	Fair	Fair	Good	Poor	Poor
Polyvinyl fluoride	PVF	Good	Good	Good	Good	Good
Polyvinylidene difluoride	PVF2	Good	Good	Good	Good	Good
High-temperature thermoplastics						
Liquid crystaline polymer	LCP	Good	Good	Good	Good	Good
Polyamide-imide	PAI	Fair	Fair	Good	Good	Good
Polyetheretherketone	PEEK	Good	Good	Good	Good	Good
Polyetherimide	PEI	Fair	Fair	Good	Good	Good
Polyphenylene sulfide	PPS	Good	Good	Good	Good	Good
Polysulfones	PSU	Good	Good	Good	Good	Good
Polyamides						
Aromatic		Good	Good	Good	Good	Good
Nylon 6, Nylon 66	PA6, PA66	Fair	Fair	Good	Fair	Fair
Nylon 12, 6/12	PA12	Poor	Poor	Good	Fair	Fair
Polyesters						
Copolyesters		Poor	Poor	Good	Good	Good
Poly butylene terephthalate	PBT	Fair	Fair	Good	Good	Good
Poly ethylene terephthalate	PET	Poor	Poor	Good	Good	Good
Polyolefins						
Cyclo olefin copolymer	COC	Fair	Fair	Good	Good	Good
High-density polyethylene	HDPE	Poor	Poor	Good	Good	Good
Low-density polyethylene	LDPE	Poor	Poor	Good	Good	Good
Polypropylene[1]	PP	Good	Fair	Good	Fair	Fair
Polypropylene copolymers		Good	Fair	Good	Fair	Fair
Polyvinyl chloride plasticized[1,2]	PVC	Fair	Fair	Good	Good	Good
Polyvinyl chloride unplasticized[1,2]	PVC	Poor	Poor	Good	Fair	Fair
Ultrahigh molecular weight polyethylene	UHMWPE	Poor	Poor	Good	Good	Good
Polystyrene/styrenics						
Acetals	POM	Good	Good	Good	Poor	Poor
Acrylics[1,2]		Poor	Poor	Good	Good	Good
Acrylonitrile butadiene styrene copolymer (Abs)	ABS	Poor	Poor	Good	Good	Good
Acrylonitrile styrene acrylate	ASA	Poor	Poor	Good	Good	Good
High heat polycarbonates		Good	Good	Good	Good	Good
Methacrylate acrylonitrile butadiene styrene copolymer	MABS	Poor	Poor	Good	Good	Good
Polycarbonates[1,2]		Fair	Fair	Good	Good	Good
Polystyrene	PS	Poor	Poor	Good	Good	Good
Polyurethanes		Poor	Poor	Good	Good	Good
Styrene-acrylonitrile copolymer (San)	SAN	Poor	Poor	Good	Good	Good
Styrene-butadiene copolymer	SBC	Poor	Poor	Good	Good	Good

[1] Radiation stable grades need to be used for radiation sterilization.
[2] PVC, acrylics and PC require corrective tint to compensate for discoloration.

References

(1) https://www.apsf.org/article/managing-luer-connections/

(2) https://en.wikipedia.org/wiki/Birmingham_gauge

(3) https://www.industrialspec.com/resources/plastics-sterilization-compatibility/

(4) https://making.engr.wisc.edu/3d-printers/

Conclusions/action items:

Begin sketching design ideas now that background research has been established.

2024/2/14 - Luer Lock Needle Design Sketch

Mateo Silver - Feb 15, 2024, 10:18 PM CST

Title: Luer Lock Needle Design Sketch

Date: 2/14/2024

Content by: Mateo

Present: n/a

Goals: Sketch out possible design implementing a manufactured needle

Content:

Background:

- After researching how luer-lock needles work, I have sketched out a possible redesign for our prototype

1) Manufactured Luer Lock Needle

- As mentioned earlier, a 7 gauge needle aligns best with the inner diameter of our current prototype

- When looking online, it has been challenging to locate a supplier for hypodermic needles, particularly one of this size

- As we are using a standardized Luer-Lock connector, we should be able to purchase the needle from any supplier

2) 1⁄4-28 to Luer Lock Adapter

- In order to adapt the Luer-Lock connection to a common thread size that we have the ability to manufacture,

a commercially available adapter can be purchased here: https://www.coleparmer.com/i/idex-threaded-luer-adapter-red-etfe-0-050-bore-female-luer-x-female-1-4-28-flat-bottom-1-ea/0201422

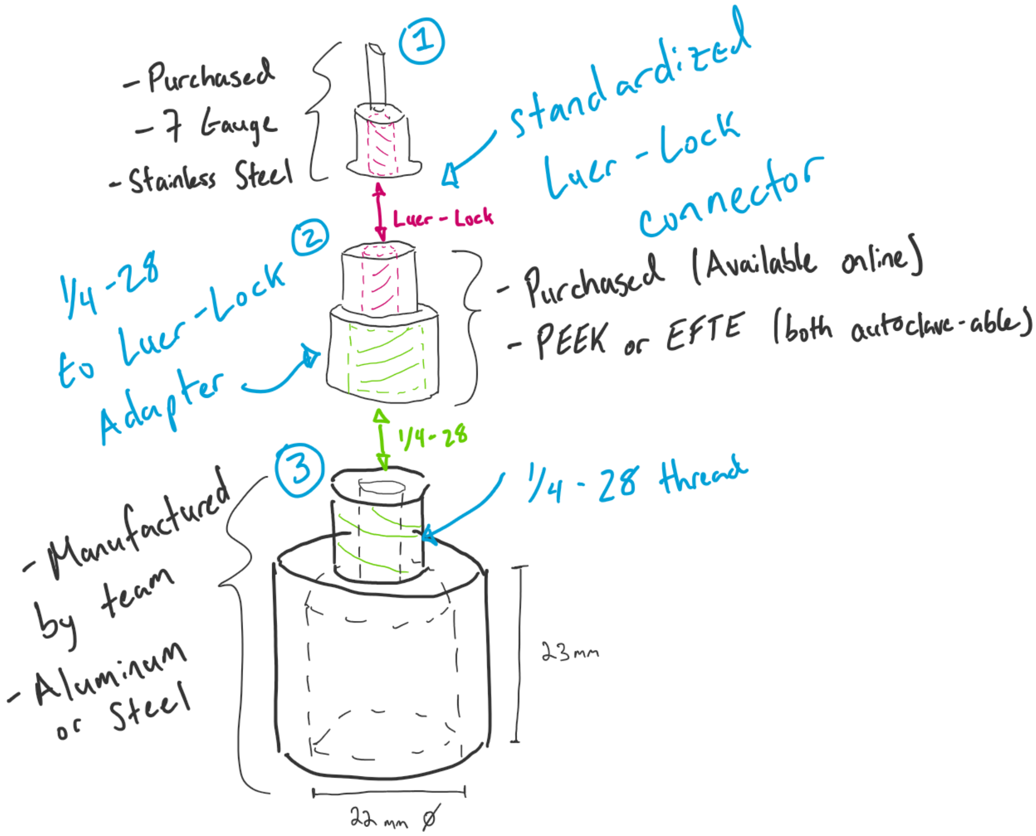
- This adapter is available in both EFTE or PEEK plastics, both of which are autoclavable (according to the chart found in the previous entry)

3) Redesigned BVM Attachment

- The final part of the design is the redesigned base of the device

- The body is the same as before, with a proper diameter to allow interface with a BVM

- Instead of a needle, a threaded flange is added, which interfaces with the Luer Lock adapter.



Conclusions/action items:

Consult with team about their design ideas. Create design matrix.

2024/2/15 - Implementing a manufactured needle - Piercing Needle

Mateo Silver - Feb 15, 2024, 10:05 PM CST

Title: Implementing a manufactured needle - Piercing Needle

Date: 2/15/2024

Content by: Mateo

Present: n/a

Goals: Investigate using a manufactured needle in our design

Content:

Background:

- During preliminary testing, our device was not sharp enough to puncture porcine skin

- A possible idea we had was to manufacture the body of our prototype ourselves, but attach it to a pre-manufactured needle

- This has the added benefit of maintaining sterility by using a new needle every time the product is used

- Additionally, we can be confident that the needle will be sharp and able to puncture through the skin and cricothyroid membrane

Piercing Needle:

- After creating a design idea with Luer Lock syringes, I looked around online to find manufacturers who we could buy hypodermic needles from.

- Unfortunately, given the large size of needle needed, and restrictions on medical device sales, it was proving difficult to find a supplier we could purchase from.

- However, one route we could take to purchase large gauge needles is through a piercing supply store

- Here [1], I was able to find needles up to 6 gauge, which is plenty large for our use.

Implementation Piercing Needles into design:

- Using a piercing needle solves many problems that the Luer Lock design had, such as limited airflow and difficulty machining.

- To attach the needle to the body of the device, we can use a technique that the TEAM lab mentioned during our consultation last semester, Shrink-fitting.

- This technique involves creating a hole in the body of the device that is slightly too small for the needle to fit into, then heating it up to make room to place the needle in.

- When the material cools to room temperature, the needle will be permanently secured.

References

[1] https://www.kingpintattoosupply.com/products/piercing-and-jewelry/piercing-supplies/needles-and-receiving-tubes/piercing-needles-6g-2-sterile-p62

Conclusions/action items:

Begin sketching design ideas using a piercing needle.

2024/2/15 - Piercing Needle Design Sketch

Mateo Silver - Feb 15, 2024, 10:19 PM CST

Title: Piercing Needle Design Sketch

Date: 2/15/2024

Content by: Mateo

Present: n/a

Goals: Sketch out possible design implementing a manufactured piercing needle

Content:

Background:

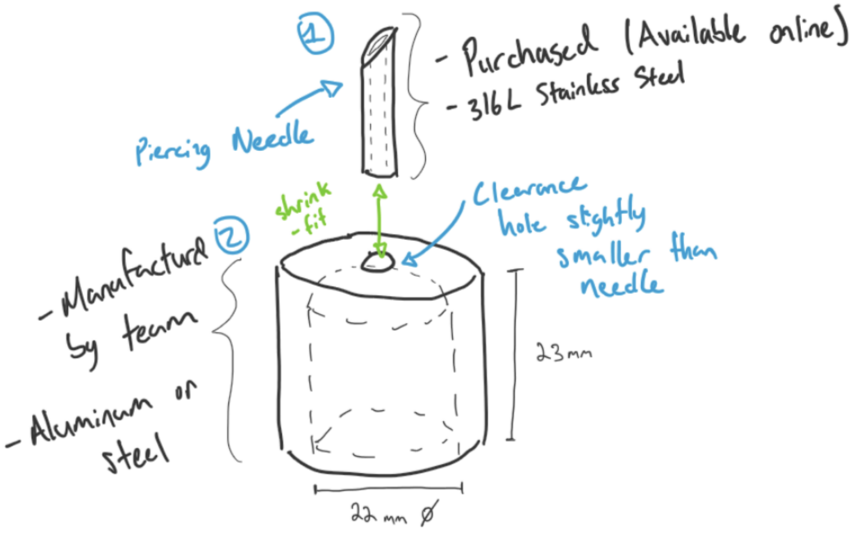
- After looking more into purchasing a Luer Lock needle, and not finding one that is a large enough gauge, I found a piercing needle that could be implemented into our design.

1) Manufactured Piercing Needle

- Piercing needles are easy to purchase online and inexpensive
- Additionally, they come sterilized.

2) Redesigned BVM Attachment

- Like the previous prototype, we could manufacture this out of aluminum
- The most difficult part would be creating the precise size hole needed to achieve a good shrink-fit
- We may have to purchase a reamer to create a hole at this precision.



Conclusions/action items:

Consult with team about their design ideas. Create design matrix.

2024/4/12 - Device Sharpening

Mateo Silver - Apr 12, 2024, 10:43 AM CDT

Title: Device Sharpening

Date: 4/12/2024

Content by: Mateo

Present: n/a

Goals: Sharpen device after failed testing.

Content:

After attempting to test today, we discovered that the device was not sharp enough. We then went in to the TEAM lab and sharpened the device, as per the fabrication instructions from our previous sharpening.

Conclusions/action items:

Test again following sharpening.

2024/4/12 - Packaging Design Initial Concept

Mateo Silver - Apr 12, 2024, 12:30 PM CDT

Title: Packaging Design

Date: 4/12/2024

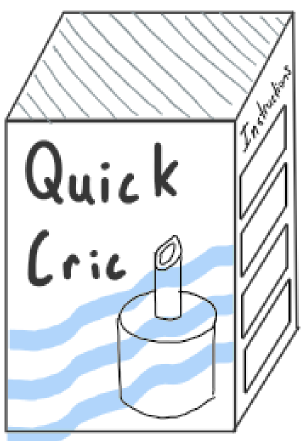
Content by: Mateo

Present: n/a

Goals: Design packaging for potential commercialization.

Content:

One of our client's goals for this semester has been to push further into commercialization of our device. In order to do this, and to use for final poster presentations, I designed a mockup of how we could potentially package our design.



Conclusions/action items:

Test again following sharpening.

2024/4/20 - Packaging Design V1

Mateo Silver - Apr 21, 2024, 7:20 PM CDT

Title: Packaging Design V1

Date: 4/20/2024

Content by: Mateo

Present: n/a

Goals: Design packaging for potential commercialization.

Content:

- I made a sample package design using a small cardstock box I had as a template.

- The box features a photo of the device on the front and back, instructions on the right side and indications for use on the left

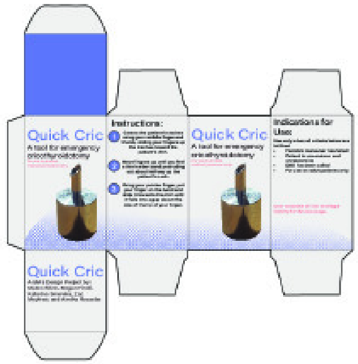
- There is clear labeling indicating that the device is to be used only by trained medical professionals, and the team is not liable for injury/death caused by usage of the device

- Attached to this entry is the pdf, and a photo of the box (printed in black and white)

Conclusions/action items:

Bring this design to team and ask for feedback.

Mateo Silver - Apr 20, 2024, 5:32 PM CDT



Download

box-template.pdf (31.9 MB)

2023/10/19 - Green Permit Training

Ma

Title: Green Permit Training

Date: 2023/10/19

Content by: Mateo Silver

Present: n/a

Goals: Show Proof of Green Permit Training

Content:

Proof of training below:

EMU

Welcome, Mateo Silver
You are logged in to the
EMU Reservation System

TEAM Lab | Reserve a Machine | My Reservations | My Status

Materials Fee is paid through 2022-06-30. See Receipt

You may apply for the following upgrades:

Name
Welding 1
CNC Mill 1
Woodworking 1
CNC Lathe Haas 1

You have the following permits and upgrades:

Name	Date
Green Permit	03/03/2022
Lab Orientation	09/27/2020
Red Permit	02/12/2022
Laser 1	10/06/2020

Conclusions/action items:

The green permit will allow me to use the mill and lathe in the team lab to manufacture our design.

2023/10/19 - Biosafety and Chemical Training

Mateo Silver - Oct 19, 2023, 9:19 PM CDT

Title: Biosafety and Chemical Training

Date: 2023/10/19

Content by: Mateo Silver

Present: n/a

Goals: Show proof of Biosafety and Chemical Training

Content:

Proof of training below:

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Mateo Silver has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2020-21 HIPAA Privacy & Security Training	HIPAA Quiz	5/20/2021	
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	1/31/2022	
Biosafety 107: Centrifuge Safety	Biosafety 107: Centrifuge Safety Verification Quiz	1/31/2022	
Biosafety Required Training	Biosafety Required Training Quiz 2022	1/31/2022	
Chemical Safety: Personal Protective Equipment	PPE Final Quiz	1/31/2022	
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/31/2022	

Conclusions/action items:

Biosafety training may be useful when we begin testing on animal models.

2024/3/15 - Tong Lecture Notes

Mateo Silver - Mar 15, 2024, 12:33 PM CDT

Title: Tong Lecture Notes

Date: 3/15/2024

Content by: Mateo

Present: n/a

Goals: Learn from and reflect on the Tong Lecture

Content:

Keys to success:
1. clinical efficacy and utility

2. Understanding of regulatory landscape and economic incentives

3. A team that is adaptable

History of exact sciences:

- founded in 1995, birth of the idea of non-invasive color cancer screening

- Went public in 2002
- test had poor efficacy struggled financially

- went under new leadership in Madison in 2009

- 2014 FDA and Medicare approval

- 2016 GI regulatory body states cologuard as screening method

Business considerations:

- problem: colonoscopies are invasive, people don't get them done. 60% of at risk population is unscreened

- Regulatory agencies: FDA, Medicare, GI guidelines

- preventing cancer is expensive, but cancer treatment is even more expensive

- how do you pitch that to regulatory bodies?

Conclusions/action

This year's Tong Lecture: Elephas

2014/02/15 - Physiological Lung Volumes

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Megan Finell - Feb 15, 2024, 9:53 PM CST

Title: The physics of human breathing: flow, timing, volume, and pressure parameters for normal, on-demand, and ventilator respiration

Date: 2/15/2024

Content by: Megan Finell

Present: NA

Goals: Research the healthy physiological lung volume necessary to fill the lungs. This is the measurement of air flow that our device should allow.

Content:

The physics of human breathing: flow, timing, volume, and pressure parameters for normal, on-demand, and ventilator respiration - PMC (nih.gov)

Volumes of air flow in the lungs:

- Adult male:
  - exchanges approximately 0.5 L (500mL) of air per breath (tidal volume) 12 times per minute at rest
- Adult female:
  - exchanges approximately 0.4 L (400 mL) of air per breath (tidal volume) 12 times per minute at rest
- individual variations due to size, age, gender, and health-state

Additional facts:

- The first 0.15 L (150 mL) volume of each breath, referred to as the tracheal dead volume, does not participate in O_2/CO_2 exchange but only fills the trachea and branching airways
- With moderate exercise, normal adults can sustain 30 breaths/minute with 3.5 L/breath
- Pulmonary function tests (PFTs) measure the absolute maximum for a single breath (forced vital capacity, FVC) in the range of 4 to 5.5 L/breath, but such levels are not sustainable

Values for normal human adult breathing at sea-level:

Condition	Rate (Breaths/min)	Tidal Volume (L/breath)	Minute Ventilation (L/min)
Nominal At-Rest	12	0.5	6
Normal Activity	16	1	16
Moderate Exercise	20	2	40
Stress Test	35	3	140
Maximum PFT*	NA	4.5	NA

Open in a separate window

*standard pulmonary function test (PFT)

Conclusions/action items:

These numbers suggest that the value of 500 mL of air should be a sufficient value to test with. Additionally, the resting breathing rate is about 12 times per minute, or one breath every 3 seconds. This means that our device should allow for 500 mL of air flow in and out every 3 seconds.

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2024/02/15 - Airflow Testing Ideas

Megan Finell - Feb 15, 2024, 9:40 PM CST

Title: Airflow Testing Ideas

Date: 2/15/2024

Content by: Megan Finell

Present: NA

Goals: Brainstorm ways to complete airflow testing through our device.

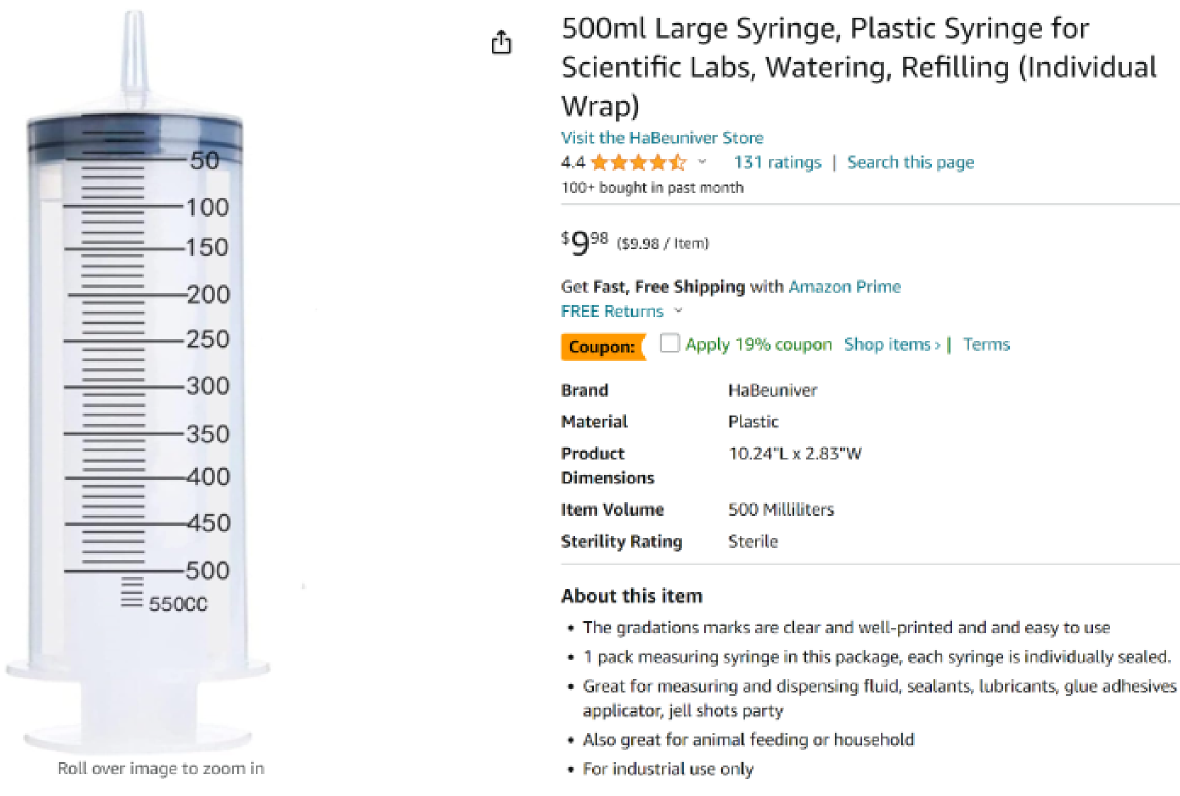
Content:

On a past team, I completed fluid flow pressure testing with water, a balloon, and a pipe on pig hearts. It was difficult to keep the water in the balloon and it took many hands to hold our testing setup together. It ended up working well and giving viable results, but it was difficult.

- This made me think that a simple idea for airflow testing may be the best option for our project this year.
- After discussing balloon testing with Dr. Suarez, it was clear that this may be too difficult.
  - Due to the elastic properties of the balloon

I remembered that one of the groups during show and tell last semester used a giant syringe to measure flow and act as a pump.

- I think this would be a great initial proof of concept test to see if 500 mL of air could be pushed through our device in 3 seconds or less



- Would need a way to keep the point of entry airtight to make sure that all the air enters the tip of our device.

Conclusions/action items:

Next, I intend to research the healthy physiological lung volume necessary to fill the lungs. This is the measurement of air flow that our device should allow.

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3/14/2024 - Applications of Biomechanics

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Megan Finell - Mar 14, 2024, 10:54 PM CDT

Title: Applications of Biomechanics

Date: 3/14/2024

Content by: Megan

Present: N/A

Goals: Research and describe various applications of biomechanics to present at our outreach activity. Consider how these can be applicable/demonstrated in our outreach activity.

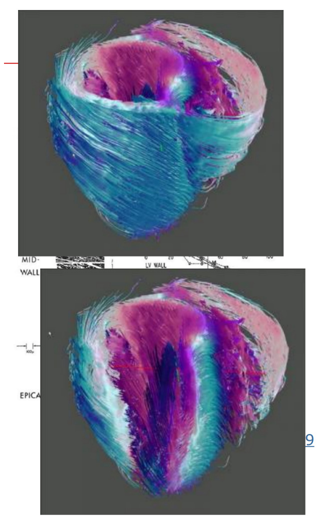
Content:

First, I looked up the formal definition of biomechanics:

- biomechanics = the application of engineering mechanics to biological processes and medical problems

Biomechanics applications that I want to highlight:

- Prosthetics
  - This is something that I used to always think of when I heard about biomedical engineering as a high schooler.
  - Also discuss how bionics and neural connections are becoming an important part of prosthetics.
- Joint implants
  - 3 main types
    - Metal-on-metal bearings
    - Metal-on-polyethylene bearings
    - Ceramic bearing
  - Important factors
    - Surface wear, inflammation in surrounding tissues, and the risk of eventual loosening of the implant
  - Joint Replacement: Implant Bearing Surface Materials | HSS
- Tissue Mechanics
  - Explain how fiber orientation is incredibly important for how tissues function (structure governs function)



    -
    - Heart-muscle fiber reconstruction from diffusion tensor MRI | IEEE Conference Publication | IEEE Xplore
    - The heart kind of "wrings" itself out when pumping blood
- Fracture fixation hardware
  - Includes screws that are implanted, plaster and fiberglass casts, and splints
  - The students will be making splints, so I'll connect this application of biomechanics to the activity that they will be completing

Conclusions/action items:

This research highlights some of the main applications of biomechanics. Our activity is meant to be an example of an iterative design process (as we have experienced through our design project). We aim to demonstrate how engineering often involves multiple rounds of problem solving to be successful. We chose to have the students design a splint with various materials given at intervals to model an iterative design process. Our activity will relate to our design project, biomechanics, and biomedical engineering as a whole.

2014/02/15

02/15/2024 - Sharpening Current Design

Megan Finell - Feb 15, 2024, 10:17 PM CST

Title: Sharpening Current Aluminum Prototype

Date: 02/15/2024

Content by: Megan Finell

Present: N/A

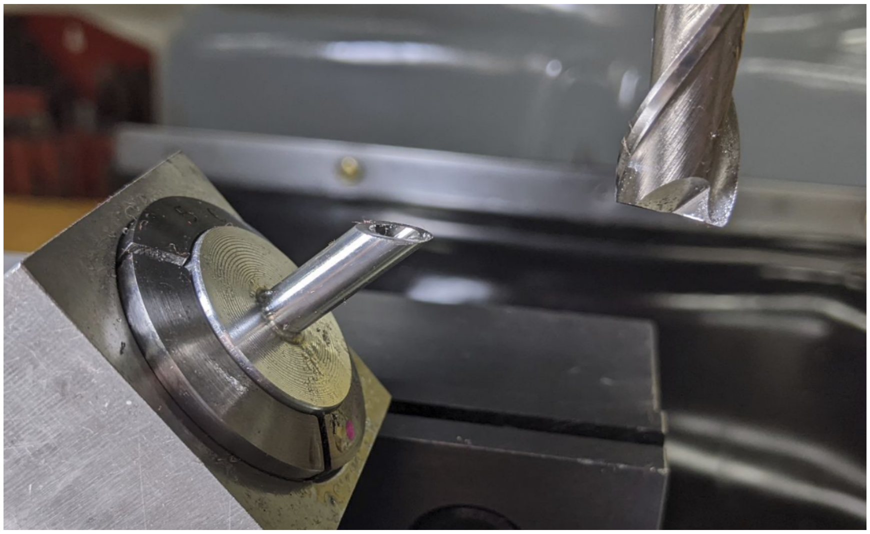
Goals: Describe idea for sharpening current design into a point.

Content:

- Based on recent testing, the current design is not sharp enough
  - I think this is because even though there is an edge, it is a rounded edge that does not concentrate pressure very well
  - Sharpening the edge to a point would allow for greater force concentration and possibly an easier time puncturing skin
  - An example of this method is common in surgical needles (as Mateo mentioned when we talked to TEAM labs earlier this week):
    - 

It is likely that this could be done to our prototype on a mill.

- Likely the easiest and fastest design modification moving forward, could probably rotate on the mill

- 

Conclusions/action items:

I think the next step in the fabrication process is to machine a sharper edge and then try testing again on the pig skin.

02/16/2024 - Redesign: Modified Lancet

Megan Finell - Feb 16, 2024, 7:34 AM CST

Title: Redesign: Modified Lancet Design

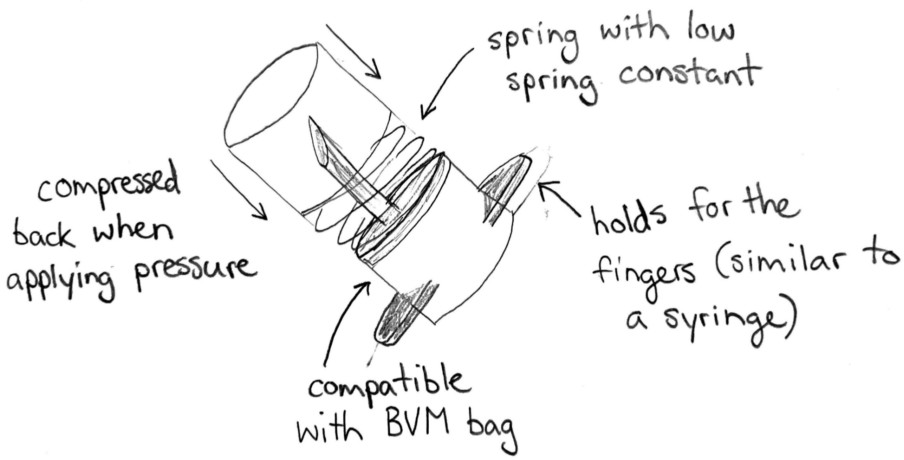
Date: 02/16/2024

Content by: Megan Finell

Present: N/A

Goals: Make a redesign that increases the sharpness of our prototype and describe how it works.

Content:



How it works:

1. Align with cricothyroid membrane.

2. Push down (spring will cause constant pressure, allowing for smoother insertion when needle tip reaches the skin)

Components:

- Buy: needle and spring
- 3D print: cap part and BVM attachment with finger holds
    - possibly include a tube running under the spring to help it hold its shape
- Machine: heat shrink needle onto base (as talked about in TEAM labs)

Pros:

- sharper
- lighter
- may be a better mechanism/more controlled

Cons:

- more complicated design
- need to apply constant pressure so that it doesn't pop out of the wound

Conclusions/action items:

Discuss with the team about which fabrication steps we want to take moving forward.

04/11/2024 - Fixation Device for Testing

Megan Finell - Apr 11, 2024, 5:13 PM CDT

Title: Fixation Device for Testing

Date: 4/11/2024

Content by: Megan

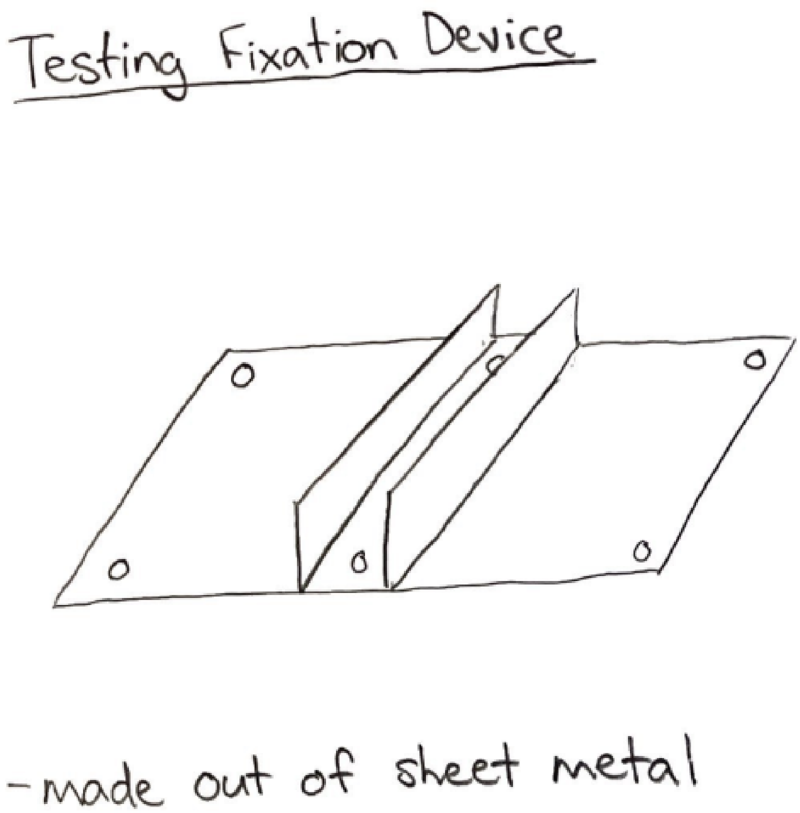
Present: Mateo

Goals: Create a device that will fixate the trachea and also allow for testing two porcine tissues at once.

Content:

For this round of testing, we needed to test two tissues at the same time (eg. skin over the trachea). Mateo and I went to TEAM labs to design and fabricate a device that would hold the trachea stable and also hold the porcine skin in tension over the trachea.

Final design we fabricated:



Fabrication notes:

1. Cut edges off (to make the sheet flat)

2. Cut U-shaped piece off the end

3. Lay U-shaped piece on top of the sheet and cut middle holes

4. Cut the 4 additional holes in the corners

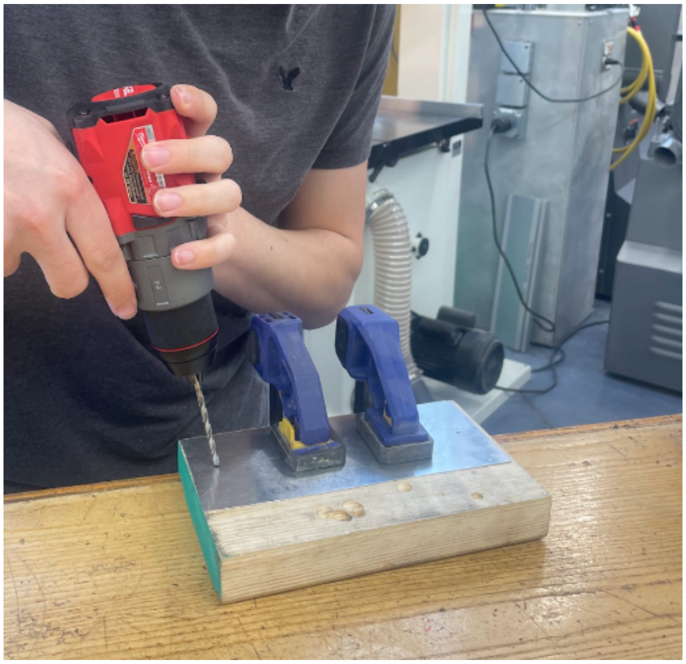
5. Bend the U-shaped piece into a U

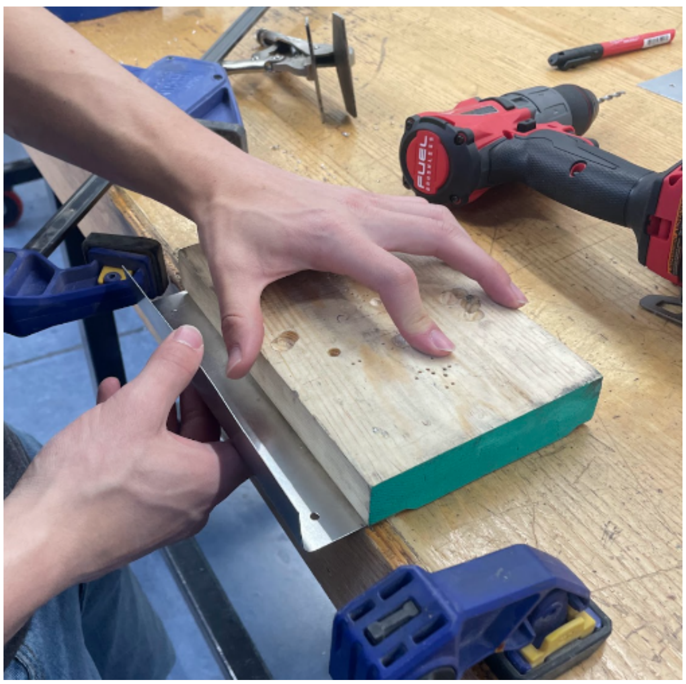
6. Bolt the 2 pieces together

Pictures from fabrication:

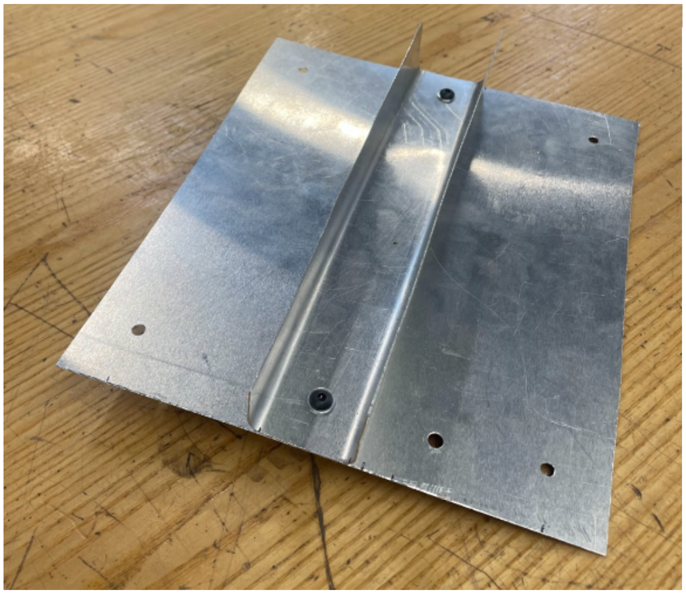
Screws, nuts, and washers we used:

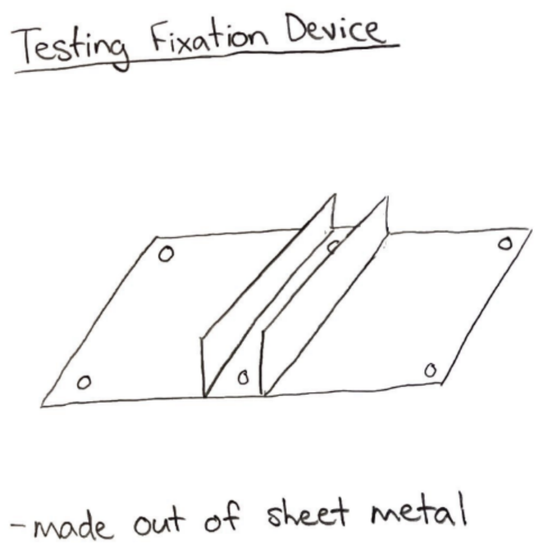
To fabricate, we first used a bandsaw, and then a hand drill and clamps:





Final fabricated design:





Conclusions/action items:

Our final prototype looks very similar to what the original drawing was. The trachea will fit in the middle U-shape and the skin will be draped over it and then screwed down in tension in the four corners. The efficacy of the design will be tested tomorrow when we use the porcine tissue samples with our prototype.

4/12/2024 - WARF information

Megan Finell - Apr 12, 2024, 10:33 AM CDT

Title: WARF Information

Date: 4/12/2024

Content by: Megan

Present: N/A

Goals: Complete research on WARF before meeting with them next week Wednesday (4/17).

Content:

The team filled out the invention disclosure form and submitted it to WARF this week (4/9). We received an email back from them and they want to informally meet with us to talk about our design.

Notes on the patenting process:

1. Submit an innovation disclosure (this is what we just did).

2. Disclosure meeting

- An informal, confidential meeting about details and possible application of the discovery or invention.

3. The decision committee makes a determination

- They try to make decisions quickly so that patenting doesn't interfere with publication.
- Decisions are based on factors like patentability, market dynamics, licensing potential, public benefit, and if WARF can add value.

4. The disclosure will go through an equity review

- The Office of the Vice Chancellor for Research and Graduate Education will perform an equity review to identify contracts or funding sources that may have intellectual property obligations.

5. Innovators with accepted inventions will enter into a memorandum agreement with WARF

- This defines the legal relationship with the team, the inventor, and WARF.
- Assign ownership to WARF so that they can work in partnership during the invention patenting and licensing process.
  - WARF will agree to share royalty income with the inventors.

6. WARF applies for the patent (this happens within several weeks)

- Work with intellectual property experts and patent attorneys to draft a patent application.
- Once filed, the patent application is examined by the patent office, a process that can take years.

Conclusions/action items:

Based on this information, it seems like we will know a lot more information after our meeting this Wednesday (4/17) about if WARF wants to move forward with our device.

02/15/2024 - Chemistry and Biohazard Safety Training

Megan Finell - Feb 15, 2024, 10:01 PM CST

Title: Chemistry and Biosafety Training Certification

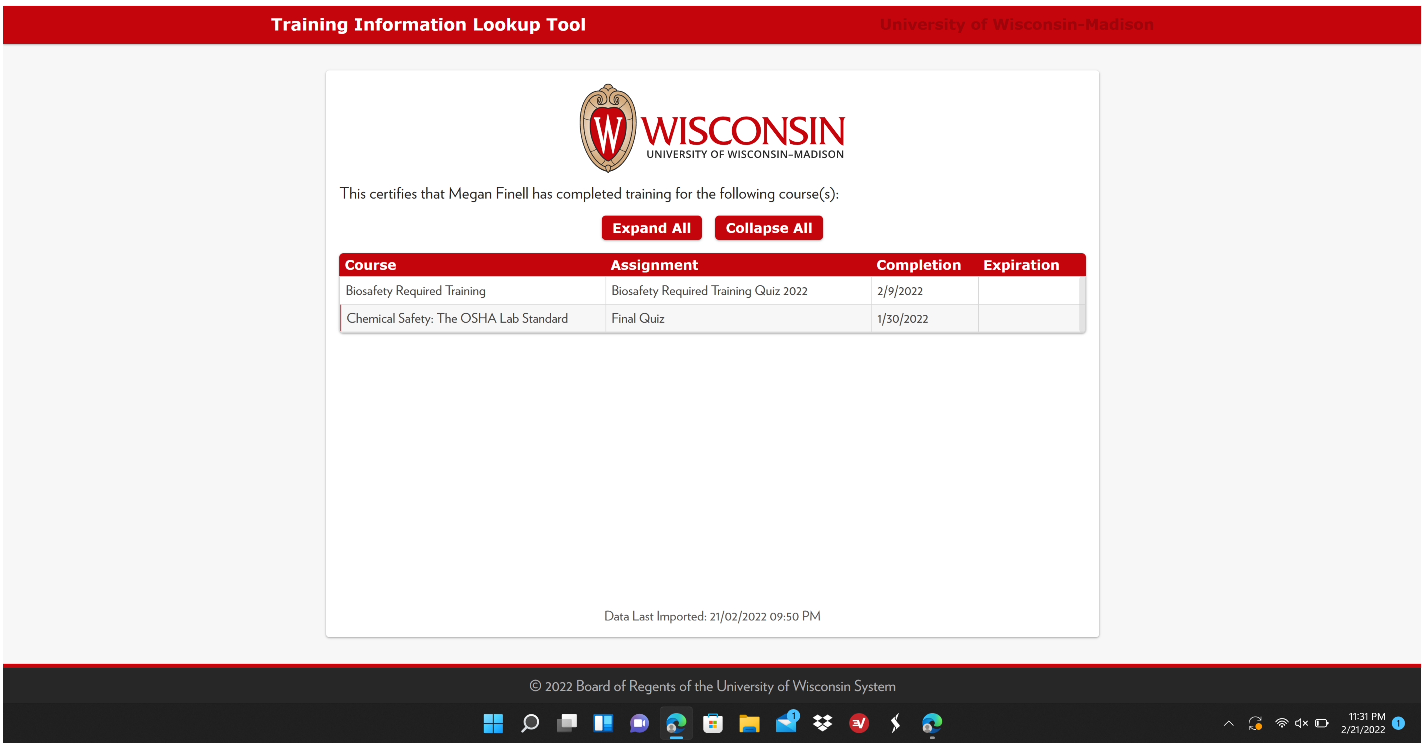
Date: 02/15/2024

Content by: Megan Finell

Present: N/A

Goals: Provide proof of completion of the chemistry training and the biosafety training.

Content:



Training Information Lookup Tool

University of Wisconsin-Madison

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Megan Finell has completed training for the following course(s):

Expand All Collapse All

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2022	2/9/2022	
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/30/2022	

Data Last Imported: 21/02/2022 09:50 PM

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11:31 PM
2/21/2022

Conclusions/action items:

Proof of chemistry and biohazard safety training (expires 2025).

02/15/2024 - Green Permit Training

Megan Finell - Feb 15, 2024, 10:01 PM CST

Title: Green Permit Training Certification

Date: 02/15/2024

Content by: Megan Finell

Present: N/A

Goals: Provide proof that I completement my green permit training.

Content:

Conclusions/action items:

This permit allows me to use the mills and the lathes in TEAM labs, so I can now do projects down there.

2024/2/15 Air Flow Research

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Zac Mayhew - Feb 16, 2024, 10:16 AM CST

Title: Air Flow Research

Date: 2/15/2024

Content by: Zac

Present: n/a

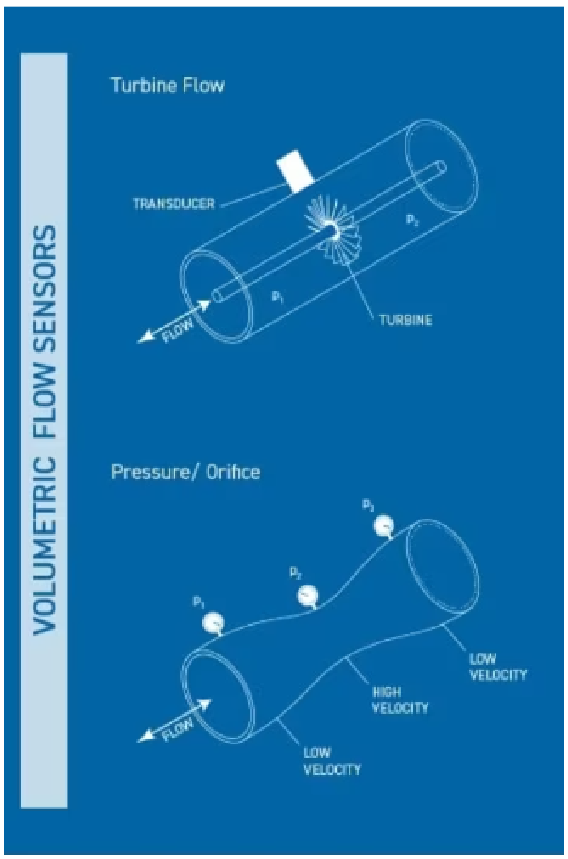
Goals: The goal of this research is to gain some insight into how we might go about measuring airflow in our device. Hopefully I can find a few methods so that if one doesn't work we can focus on another.

Content:

Source: https://www.arrow.com/en/research-and-events/articles/pressure-sensors-types-in-medical-applications

Volumetric Airflow:

- Turbines
  - Not super accurate, but good for a good estimate.
  - Use the speed of the turbine to determine the velocity of the air pushing against it.
- Multiple Pressure Sensors
  - Multiple pressure sensors are used between points where area the air is passing changes.
  - Using Bernoili's equation you can calculate the velocity of the air.



- Mass Flow
  - Hot wire anemometer
    - Measures the current to keep a probe at a constant temperature as it is cooled by the passing air.
    - Cannot determine flow direction but is good at finding flow of a known gas.
  - Thermal Mass Flow
    - Same idea as hot wire but holds at a constant current instead of temperature.
    - Measures the difference in temperature between two points and can determine direction.

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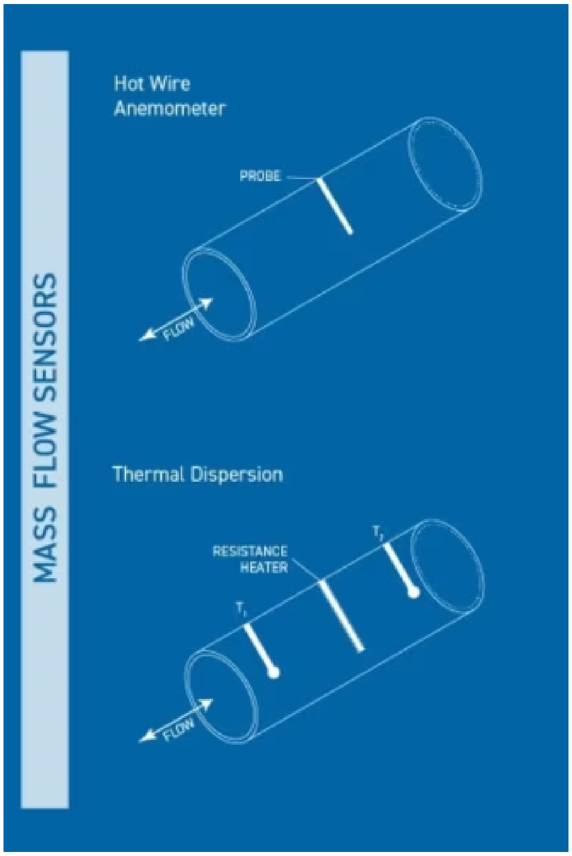


Conclusions/action items:

Meet with team and see if they found similar ideas or maybe something different we could try. It would be nice to know if we have any of these devices on campus that we could use without having to purchase one. Might be good to reach out to some professors in mechanical engineering since they would have a good idea hopefully.

2024/3/5 Human Breath Velocity

Zac Mayhew - Apr 24, 2024, 8:56 AM CDT

Title: Human Breath Velocity Research

Date: 3/5/2024

Content by: Zac

Present: n/a

Goals: The goal of this research is to determine the average velocity of the human breath to use in our SolidWorks airflow testing.

Content:

Link: https://pubmed.ncbi.nlm.nih.gov/28154922/#:~:text=Peak%20air%20velocities%20varied%20for,m%2Fs%20(coughing).

- I chose to look at the blowing velocity because that would line up closest with the motion the person using our device would do.
- In our scenario, the person would most likely not be blowing as hard as possible like in the study
- Since the person won't be blowing as hard as possible, this is more of a max value to see if our device would work
- Peak velocities varied between 6 and 64 m/s
- Mean velocity for blowing was 12 m/s
- For the solid works simulation, I think 12 m/s would be a good input velocity

Conclusions/action items:

Now that I have the average velocity for someone who is blowing. I can conduct the SolidWorks testing to see whether or not our device will pass a sufficient amount of air.

2024/2/13 Handle Design

Zac Mayhew - Feb 15, 2024, 12:08 PM CST

Title: Handle Design

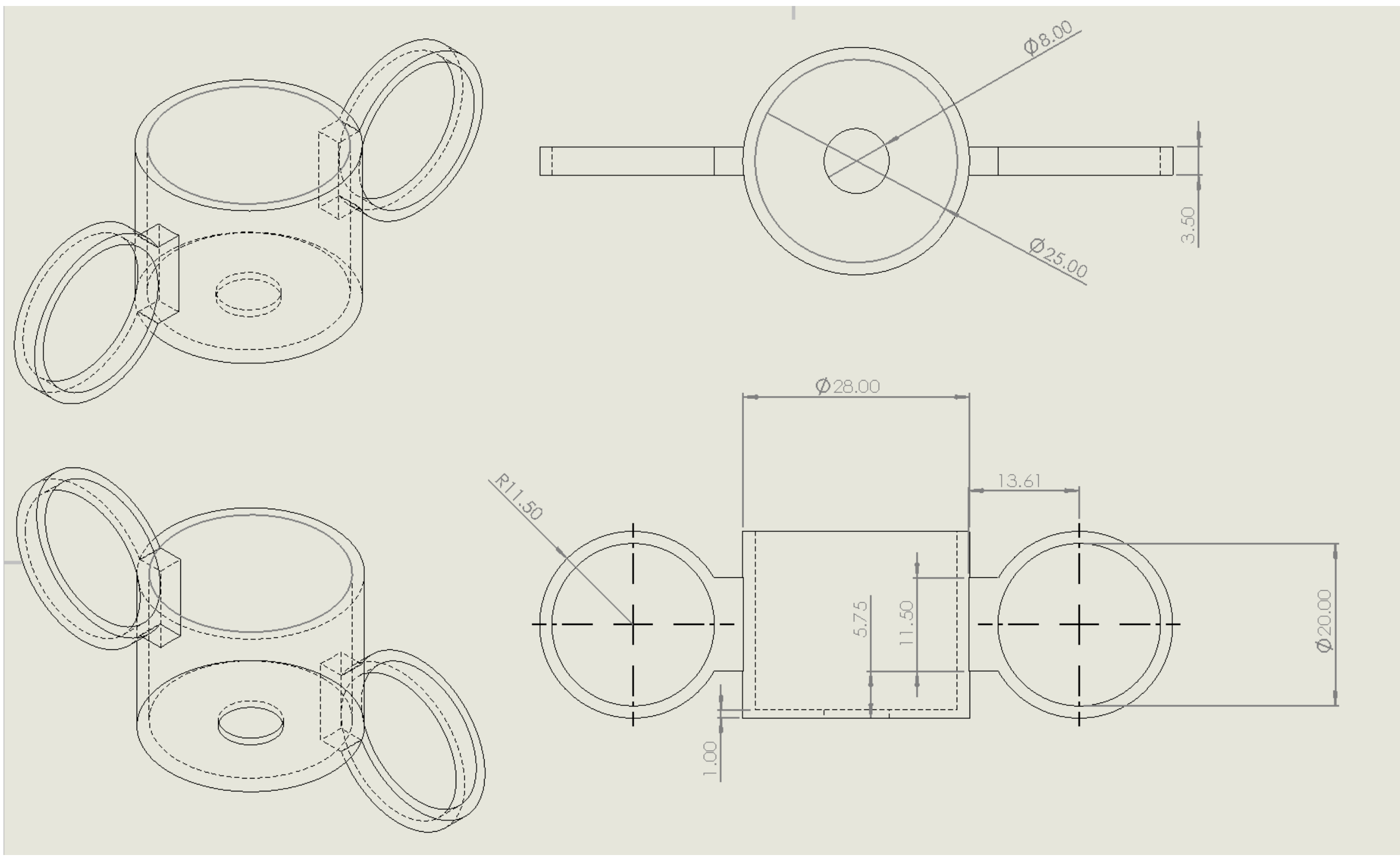
Date: 2/13/2024

Content by: Zac

Present: n/a

Goals: The goal of this design was to design a 3d printable handle that could fit around the current device to make it more ergonomic.

Content:



The handle device would simply slide over the current design. Inspiration was taken from a syringe that uses the two holes for your fingers.

Conclusions/action items:

Print the design and test it with the device and puncturing the pork skin.

2024/2/15 Cap Design

Zac Mayhew - Feb 15, 2024, 11:55 AM CST

Title: Cap Design

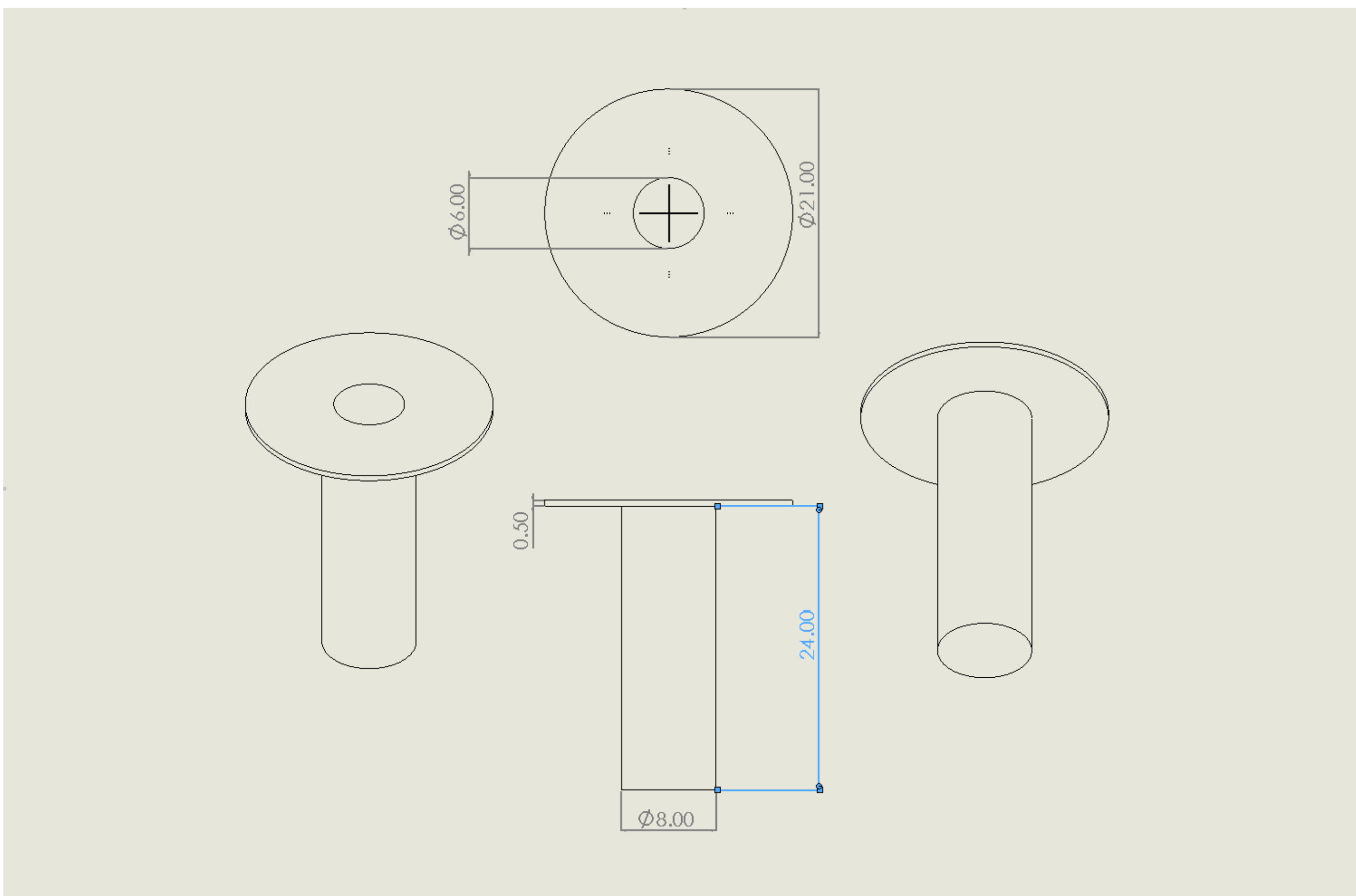
Date: 2/15/2024

Content by: Zac

Present: n/a

Goals: The goal of this document was to design a cap that will work with my handle design in order to cover the sharp point of our device when it isn't being used.

Content:



The idea behind this cap is that you can control the fill on a 3d printer so the fill would be lower so that when it is time to remove it the bottom part could be easily pulled off the top piece. I'm not 100% sure this will work but in theory it should be thin enough that you could pull it apart without too much hassle.

Conclusions/action items:

Bring to team and see what they think.

2024/2/15 Handle Cap Assembly

Zac Mayhew - Feb 15, 2024, 12:10 PM CST

Title: Handle Cap Assembly

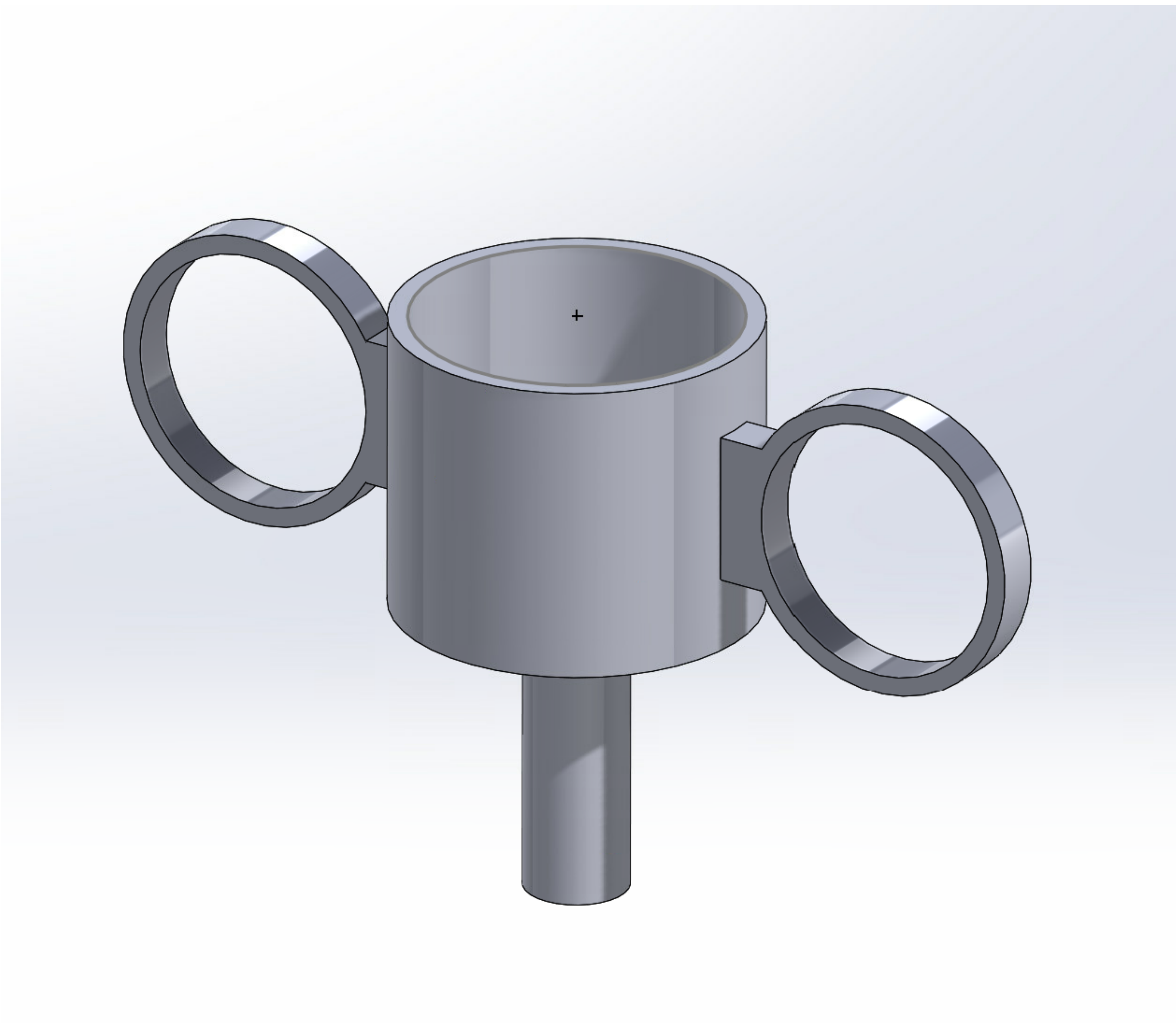
Date: 2/15/2024

Content by: Zac

Present: n/a

Goals: The goal of this is just to show what the handle and cap would look like when they are put together.

Content:



Conclusions/action items:

n/a

2024/2/15 Needle Insert Design

Zac Mayhew - Feb 15, 2024, 12:18 PM CST

Title: Needle Insert Design

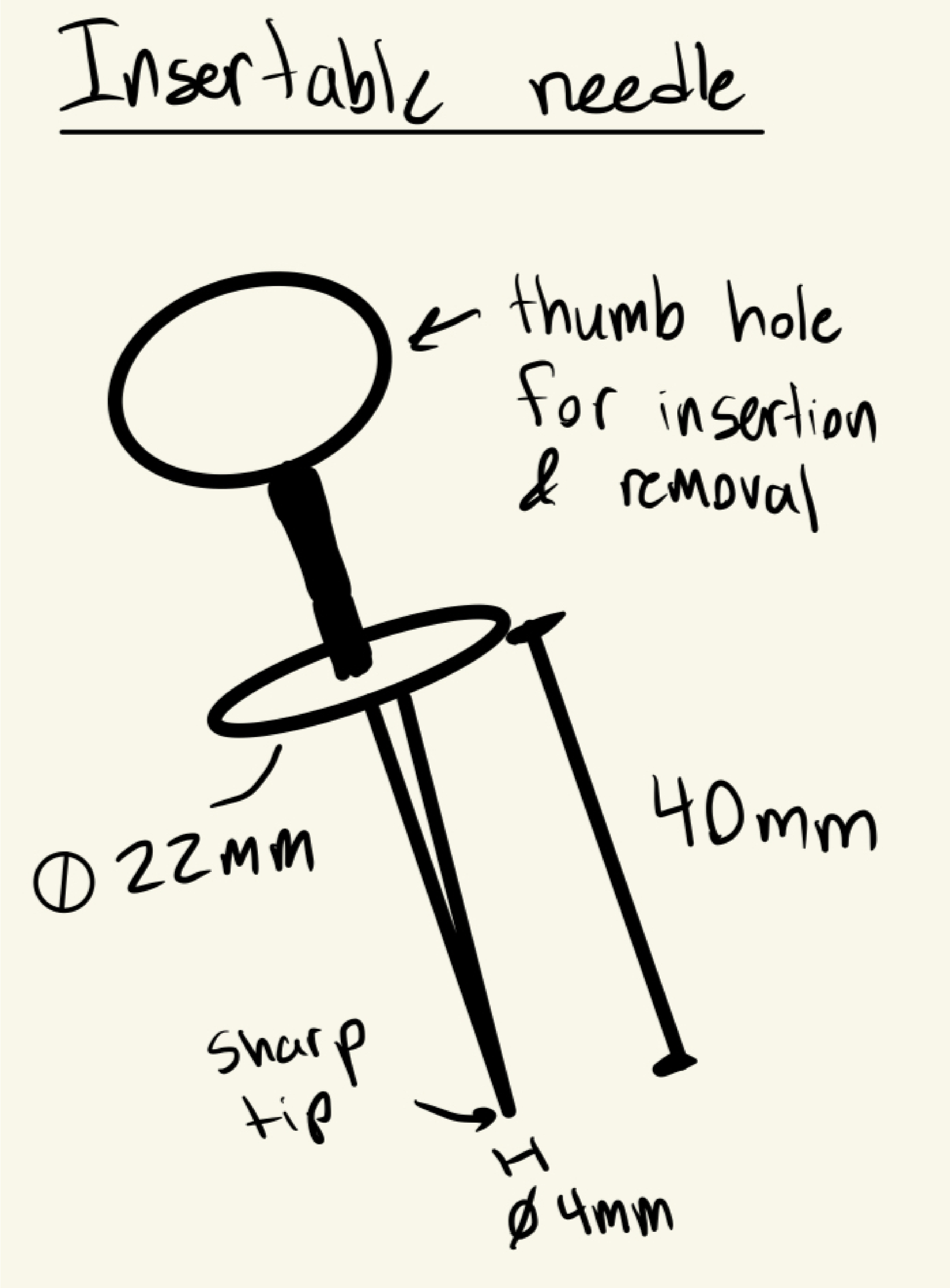
Date: 2/15/2024

Content by: Zac

Present: n/a

Goals: The goal of this design is to come up with a way to puncture the skin since our original prototype failed. I wanted to see if I could keep the old design and add a new component that could puncture so we don't have to refabricate it.

Content:



This design is able to fit into the current design.

Conclusions/action items:

Share idea with team and compare with their ideas and maybe combine some of them to fix the problem.

2024/4/12 Handle Design Update

Zac Mayhew - Apr 12, 2024, 10:19 AM CDT

Title: Updated Handle Design

Date: 4/12/2024

Content by: Zac

Present: n/a

Goals: The goal of this update is to make the handles distribute stress better.

Content:

Conclusions/action items:

The added thickness to the handles and fillets where the handle connects to the body should help distribute stress so it doesn't break

2024/6/3 SolidWorks Airflow Testing

Zac Mayhew - Mar 12, 2024, 8:09 PM CDT

Title: SolidWorks Airflow Testing

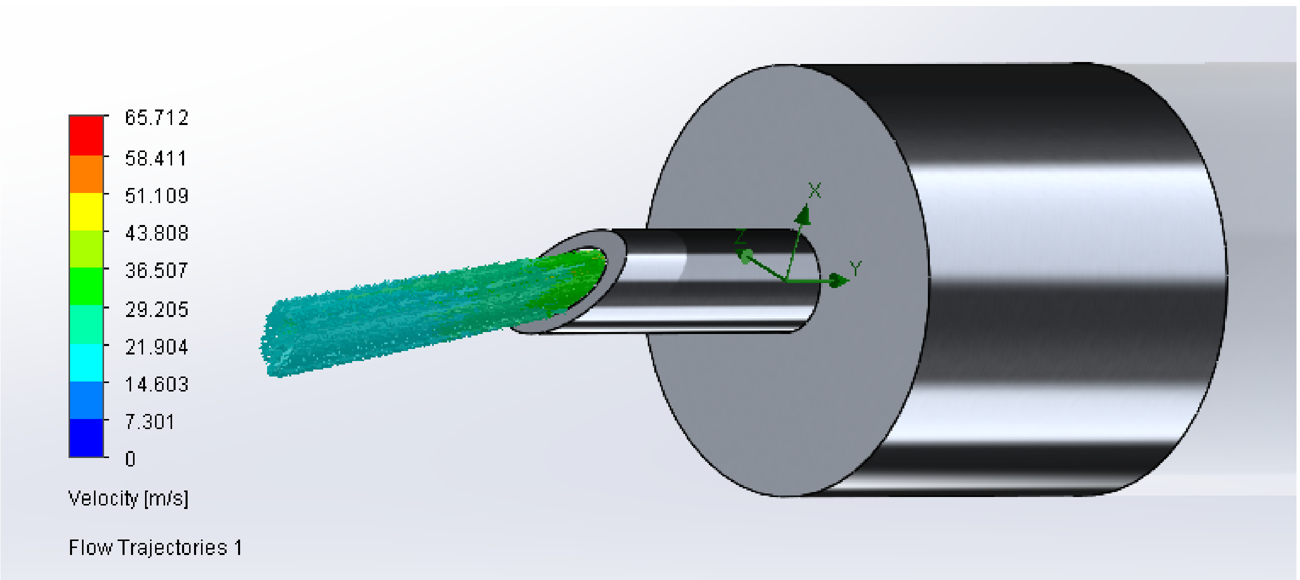
Date: 3/6/2024

Content by: Zac

Present: n/a

Goals: The goal of this testing is to use SolidWorks Airflow simulation to see of 500 mL of air can move through the piece in 3 seconds.

Content:



If you look, the color of the airflow coming out of the device equates to about 30 m/s. If you multiply the velocity by the area, you get an airflow of around 1.5 L/s. This is much larger than our target and therefore our device would work. The input airflow was 12 m/s and was determined because that is the average velocity produced by humans when blowing.

Conclusions/action items:

We now know that our device meets the clients requirements for airflow.

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items:

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Notebook attachment file

KATERINA SMEREKA - Jan 31, 2024, 9:27 PM CST

BME Design-Fall 2023 - Zac Mayhew
Complete Notebook

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KATERINA SMEREKA

on

Jan 31, 2024 @[illegible] PM CST

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