BME Design-Spring 2026-EndoVAC
Complete Notebook

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YEANNE HWANG

on

Apr 29, 2026 @10:20 PM CDT

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Team contact Information

SIMON FETHERSTON - Jan 30, 2026, 11:58 AM CST

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Project description

MARIAH SMEEDING - Jan 26, 2026, 10:18 AM CST

Course Number: BME 301 sec 301

Project Name: Democratizing placement of endoluminal negative pressure devices for gastrointestinal leaks

Short Name: Endoluminal Vacuum Therapy for GI Leaks

Project description/problem statement: Anastomotic leaks, or defects where surgically connected parts of the intestine leak, require invasive surgery to fix. These are serious complications that can happen after GI surgery. The current solution to this is VAC (Vacuum-Assisted Closure) therapy and it works very well for external wounds and has been adapted for GI defects. When placed inside the GI tract, either inserted through the mouth or anus using an endoscope, it achieves successful results where about 90% of these serious defects can heal without additional surgery. The current limitations however are that this treatment requires skilled endoscopic manipulation and a labor-intensive placement process. Our goal through this project is to develop a streamlined deployment system that makes VAC therapy into the GI tract easy to perform, less dependent on advanced endoscopic skills, and more widely adoptable by surgeons.

About the client: Amber L. Shada, MD, FACS, is fellowship trained in Advanced Endoscopic and Laparoscopic Gastrointestinal Surgery, and is board certified in General Surgery. She specializes in minimally invasive techniques for esophageal and gastric disorders, abdominal wall hernias, and gall bladder disorders. She also has special expertise in advanced endoscopic surgery. Dr. Shada's research interests focus on endoscopic device development, clinical trials in esophageal, foregut, and general surgery, and clinical outcomes in esophageal and foregut surgery.

01/30/2026 Questions for First Client Meeting

SIMON FETHERSTON - Jan 30, 2026, 3:54 PM CST

Title: Questions for First Client Meeting

Date: 01/30/2026

Content by: All team members

Present: All team members

Goals: Generate a list of questions to bring to the first client meeting with Dr. Shada

Content:

Questions:

- Should our project be more geared towards upper GI tract or lower GI tract? Or should our design be ideal for both?
- What surgeries are you performing that are resulting in GI leaks?
- What is the size range of cavities we should be designing our device to treat? (product specifications)
    - Would you like a one size-fits all tube or be able to be modified depending on the patient? (patient considerations)
- What are some challenges encountered when using an endoscope?
    - What steps make the procedure labor intensive?
- Which method do you currently use to place the sponge?
    - What challenges occur with the current method?
    - What improvements would you like to see to this design/method? (design specifications)
- Are you looking for an alternative method of placing the sponge or adapting the current design?
    - Materials requirement?
- Budget?
    - Cost per unit?
- Is this a design that should be made in bulk or focus on one aspect of the procedure? (product quality)
- Is the patient typically under anesthesia while undergoing the procedure? (patient considerations)
- How will the equipment be stored? Is this a consideration we should think about in our design? (operating environment)
    - How long should the sponge/delivery system last before usage? (shelf life)
    - How many times can the device be used? (life in service)

Conclusions/action items: This list of questions will be used to focus the project and determine the direction to purse with the design. After meeting with Dr. Shada, we will be able to complete our product design specifications. These questions, the meeting, and any follow up questions will be used to form the preliminary design ideas and design specifications.

- Meet with Dr. Shada on 02/04/2026
- Complete product design specifications document

09/12/2026 Initial Design Ideas Meeting

SIMON FETHERSTON - Feb 12, 2026, 3:59 PM CST

Title: Initial Design Ideas Meeting

Date: 09/12/2026

Content by: Team

Present: Team

Goals: Discuss individual initial design ideas to help prepare designs for a design matrix

Content:

A pdf is attached to this entry. This document shows pictures of various initial design ideas that the team will narrow down for a design matrix.

Conclusions/action items: These initial designs are a crucial first step toward creating a design matrix and choosing a design. The team discussed the various designs so that they were all understood. The team will look to narrow these ideas down to three. Three main designs will then be assessed in a design matrix.

- create design matrix and criteria

SIMON FETHERSTON - Feb 12, 2026, 4:00 PM CST

Download

Design_Ideas.pdf (7.81 MB)

03/09/2026 Meeting with Dr. Ohnsorg

MARIAH SMEEDING - Mar 11, 2026, 12:03 PM CDT

Title: Meeting with Dr. Ohnsorg

Date: 03/09/2026

Content by: Team

Present: Team

Goals: Discuss potential materials and chemistries that could be used to make the film

Content:

PEG will not degrade on its own

Consider biodegradable polymer

Film blow - potential option to seal

- can film blow LDPE
- What is the Tg, Tm
    - Equivalent in a biodegradable polymer

PVA "can" go under enzymatic degradation - look up (citric acid cycle)

Look at polymers that include an ester bond in the backbone (give degradability factor)

Materials - FDA approved

- PVA - questionable
- PLGA
- PLA - good HMW
- PCL
- Alginate - Calcium chloride

Processability is the first key to look at

- molecular weight is key
- HA - potential mix with PLA (blends)
    - Heat press

If using liquid nitrogen - consider heat transfer

Polymer with UCST - heating goes to one phase

- LCST - cool it down it goes to a liquid

Conclusions/action items: The content discussed during this meeting will be used to facilitate research on potential biomaterials. The team will continue looking at options to create a list of potential biomaterials. These materials will then be ordered and fabricated to test their properties.

02/04/2026 Initial Client Meeting

SIMON FETHERSTON - Feb 04, 2026, 6:02 PM CST

Title: Initial Client Meeting

Date: 02/04/2026

Content by: Team

Present: Team

Goals: Meet with Dr. Shada to discuss the project and initial design requirements

Content:

During this meeting we asked our prepared questions and took notes regarding the project.

- Should our project be more geared towards upper GI tract or lower GI tract? Or should our design be ideal for both?
    - Both ideal but possibly towards upper
- What surgeries are you performing that are resulting in GI leaks?
    - Various endoscopy procedures
- What is the size range of cavities we should be designing our device to treat? (product specifications)
    - Min 2cm to fit in device-up to no limit (2 & 15cm)
    - Would you like a one size-fits all tube or be able to be modified depending on the patient? (patient considerations)
- What are some challenges encountered when using an endoscope?
    - Deployment - hard to push the sponge down
    - What steps make the procedure labor intensive?
- Which method do you currently use to place the sponge?
    - Piggy Back, using forceps
    - What challenges occur with the current method?
        - Driving the endoscope and NG tube down to spot
        - 2x2x3 cm foam
        - Once in the esophagus is it easier to shove into a hole with grabbers - not pretty
        - Nothing to hold sponge in place besides vacuum once put in cavity
- Are you looking for an alternative method of placing the sponge or adapting the current design? Yes - esophageal cavity size limits sponge size.
    - Materials requirement?
        - Currently using black sponge by KCI (originally for external wound)
    - Have you seen the endosponge? If so, what are its limitations?
    - There is no commercially available vacuum, what system do you use?
- Budget? $500 - $1000
    - Cost per unit?
    - Materials - sponge, tube, suture?, grasper

- Is this a design that should be made in bulk or focus on one aspect of the procedure? (product quality)
- Is the patient typically under anesthesia while undergoing the procedure? (patient considerations) - yes especially upper
    - What environment is the procedure performed in? OR?
- How will the equipment be stored? Is this a consideration we should think about in our design? (operating environment)
    - How long should the sponge/delivery system last before usage? (shelf life)
    - How many times can the device be used? (life in service)
- Accuracy and reliability?
    - Works in order of 90% of the time (or greater) especially in GI tract
    - Can take a couple weeks of exchanges to get things closed but big operations are last resort (risky)

- Leak compilation after another surgery is why a sponge is placed
    - Leak rate esophagus higher same with lower
    - Already infection happening when sponge is placed
    - Biosensor could be helpful for the stomach
- Sew sponge using heavy suture
- 9.9mm endoscope - diameter
- 2x2x3 cm foam
- Lift patients chin to open airway
- “Shove into the hole”
- KCI black foam sponge
    - Not meant for endoVAC procedure
    - Meant for external wound
- Bacterial burden on lower GI tract
- At least 2cm to fit the device
    - Defect has to be small enough to use a sponge
    - Has done as large as 15-18 cm in size
    - 2-15 cm defect
- Difficulties
    - How difficult it is to deploy
    - Limited by size of the esophagus
    - Using the right material for the procedure
        - Is black granufoam the right thing
- 2-4 thousand for final unit
- 500-1000 budget
- Patient already has antibiotics
    - Infection is already present

    - Less infection/cleaner with each exchange
- Patients are under anesthesia
- Length of procedure:
    - Depends on location of cavity
    - Can take from 30 min to 3-4 hours

Conclusions/action items: We were able to gather a better understanding of the project after this meeting. We still need to narrow down the focus so we can have a concrete understanding of what to aim for in the design. We will use the information from this meeting to complete our product design specifications.

02/18/2026 Preliminary Presentation Meeting

SIMON FETHERSTON - Feb 27, 2026, 12:42 PM CST

Title: Preliminary Presentation Meeting

Date: 02/18/2026

Content by: Team

Present: Team

Goals: Discuss design matrix and funding

Content:

Degradable coating:

Important to consider pH - cavities could be acidic

More compelling if doable

On-table x-ray of diameter change of sponge

- How do you know if it has reached the true size

Future works - application of nanoparticles

Cap Delivery:

Not sure about compressibility of design

Can the cap be removed? - something like seamguard

- could make this design better
- would be best if the cap could just be released and come out

Design matrix:

Good design matrix categories

Placement time of under 5 minutes to deploy stent - ideal circumstances

A lot of wiggle-room with accuracy - depends on surrounding structure

- lung moves the most
- when used for skin wounds whole cavity is filled with sponge
- sizing does not have to be exact

Testing:

Have vacuumed oranges as a model

3D print esophagus model - create flexible abscess

Could use pig esophagus for degradable coating model

Conclusions/action items: This client meeting was helpful at selecting a design and determining what aspects of the project to focus on. After this meeting, it was decided that the degradable coating design would be the best design to purse. The team will work on finalizing materials and ordering them after completion of the preliminary report.

03/04/2026 Materials Meeting

MARIAH SMEEDING - Mar 11, 2026, 11:59 AM CDT

Title: Client Meeting to Discuss Materials and Expenses

Date: 03/04/2026

Content by: Simon

Present: N/A

Goals: Create a plan to order and acquire materials

Content:

10-16 F NG tubes

- Could see effect of different tube size
- Receiving pairs of 12 and 16 F tubes

Determine what 3D printed models are made of

- Plastic?

Conclusions/action items: During this meeting, the team discussed future fabrication plans and the need for acquiring materials. Dr. Shada has many materials and will assemble them for pick up next week. After the advisor meeting on Friday, the team will know what materials they need to order that are not already in the lab.

- Order materials

02/12/2026 Design Matrix

SIMON FETHERSTON - Feb 12, 2026, 8:06 PM CST

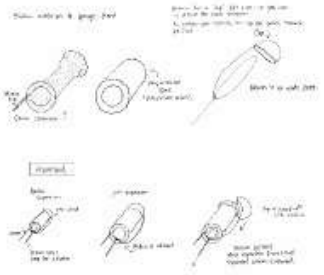


Figure 1. Balloon Sponge-Stent

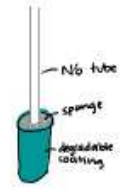


Fig ure 2. Degradable Coating Design

Download

EndoVAC_Design_Matrix.pdf (690 kB)

02/25/26 - Universal Design Considerations

MARIAH SMEEDING - Feb 25, 2026, 2:01 PM CST

Title: Universal Design Consideration

Date: 02/25/26

Content by: Mariah Smeeding

Present: Mariah, Evelyn, Simon

Goals: Identify components of our design that could be more universal

Content:

What components of our design can be improved?

- Adjustability of the portion inserted into the cavity should be considered so our device can treat a range of leak sizes.

Which of the 7 principles are we addressing?

- 2 - Flexibility in use
- 3 - Simple and Intuitive Use

How can we make these improvements?

- Glueing sponge to vacuum catheter rather than suturing for more intuitive use
- Consider how we can make a compressed sponge adjustable - maybe during manufacturing. Having three sponge sizes and each can cover a wide range of cavity sizes.

Conclusions/action items:

research material choices for degradable coating and what shapes of polyurethane sponge we should use

04/29/2026 Materials and Expenses

SIMON FETHERSTON - Apr 29, 2026, 10:00 PM CDT

Title: Materials and Expenses

Date: 04/29/2026

Content by: Simon

Present: Simon

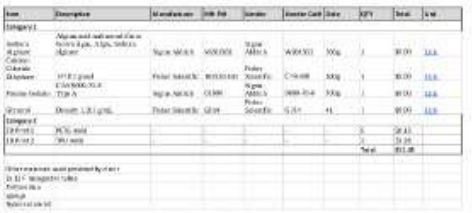
Goals: Display materials and expenses for the project

Content:

The attached PDF show the list of expenses for the project, along with materials provided by the client.

Conclusions/action items: These materials were used to fabricate and test the design. Some of the materials were provided by the client or were included in the lab, thus not being included in the cost. Overall, only the 3D printed materials attributed to the cost.

SIMON FETHERSTON - Apr 29, 2026, 10:00 PM CDT



Download

BPAG_Expense_Spreadsheet_-_Sheet1.pdf (68.3 kB)

03/16/2026 Gelatin First Attempt Film

Evelyn Mikkelson - Mar 16, 2026, 2:09 PM CDT

Title: Gelatin and Sodium Alginate Film Fabrication

Date: 2026/03/16

Content by: Evelyn Mikkelson

Present: Evelyn, Simon, Mariah

Goals: Make a first run of gelatin film, so we can present it at show and tell.

Content:

Gelatin

Materials:

- Fisher Science Education Portable Balance, Model: SLF303
- Small weigh boat
- Scoopula
- 100 mL beaker
- 100 mm x 20 mm pyrex petri dish
- Magnetic stir bar
- Fisherbrand Isotemp Digital Hotplate Stirrer **- DATAPLATE Digital Hot Plate/Stirrer**
- Porcine Gelatin: Sigma-Aldrich
  - Type A, CAS 9000-70-8, 70-90% protein, MW 50-100 kDa, powder form
- Glycerin: Fisher Scientific G314
  - Density 1.261 g/mL
- 10 mL serological pipette
- 1 mL serological pipette
- Fume hood

Procedure:

1. Setup fume hood for use
   a. See instructions on the fume hood for proper setup
2. Prepare gelatin powder
   a. Zero a small weigh boat using scale
   b. Measure 2.5 g of 300 g bloom porcine gelatin in the weigh boat using a scoopula [1] **- 2.598g**
   c. Transfer gelatin powder to 100 mL beaker **- measured 100mL water in beaker and added gelatin after**
3. Place 100 mL beaker with gelatin powder on a hot plate in a fume hood
4. Using a serological pipette, add 50 mL of deionized water to the beaker
5. Place magnetic stir bar and turn on hot plate **- wait until gelatin is dissolved to add glycerin**
   a. Set magnetic stir to a medium-low speed (~400 rpm) **- set -> rpm -> 400 -> set**
   b. Set temperature to 50°C **- set -> plate temp -> 50 -> set**
6. Add glycerin to beaker at a ratio of 20% weight relative to the mass of gelatin used **- added glycerin powder directly to gelatin solution**
   a. For this application, use 0.5 g of glycerin

b. Measure 0.5 g of glycerin and add to beaker using the same steps as 2a-2c

7. Allow gelatin-glycerin solution to mix for 30 minutes at 50°C to ensure homogenous solution
8. Transfer 20 mL of mixed solution to pyrex petri dish **- used 2 plastic 100mm x 20mm petri dishes, using serological pipette**
9. Allow solution to solidify at room temperature for 12 hours
10. Place petri dish with solid gel in drying oven at 50°C for 12 hours to achieve final glycerin-gelatin film
    a. Ensure the oven being used is inside of a fume hood as heating glycerin can produce harmful vapors

Sodium Alginate

1. Setup fume hood for use
    a. See instructions on the fume hood for proper setup
2. Prepare dissolved sodium alginate solution
    a. Zero a weigh boat using scale
    b. Measure 1.6 g (2% w/v) sodium alginate in the weight boat using a scoopula [1] **- 1.604g**
    c. Transfer sodium alginate powder to 100 mL beaker
    d. Place 100 mL beaker with sodium alginate powder powder on a hot plate in a fume hood **- alginate and then water, the alginate would not dissolve/mix with water - used a popsicle stick to push down - tried using glass stir rod to mix**
    e. Using a serological pipette, add 80mL of distilled water to 100mL beaker
    f. Place a magnetic stir into the 100mL beaker and turn on hot plate:
        i. Set hot plate to 60 ± 0.5 °C
        ii. Set magnetic stir to a medium-low speed (~400 rpm) **- rpm to 500 to try to force mixture**
        iii. Leave to stir for 1 hour - **added 0.8g glycerin, it was supposed to be used in original mixture - used glass stir rod to mix - rpm to 800**
    g. After 1 hour, pour mixture into a petri dish
    h. Place the petri dish with mixture in a drying oven set to 60°C for 24 hours to form film
3. Prepare 0.8 M calcium chloride crosslinking solution
    a. Zero a small weigh boat using scale
    b. Measure 11.76 g of calcium chloride into the weigh boat using a scoopula [1]
    c. Transfer calcium chloride to a 400mL beaker
    d. Place 400 mL beaker with calcium chloride powder on a hot plate in a fume hood
    e. Using a serological pipette, add 100 mL of distilled water to 400 mL beaker
    f. Place magnetic stir into the 400 mL beaker and turn on hot plate:
        i. Set magnetic stir to a medium-low speed (~400 rpm)
        ii. Leave to stir for 15 minutes
4. Immerse sodium alginate film in calcium chloride solution
    a. Remove sodium alginate film from oven and remove the film from the petri dish
    b. Submerge sodium alginate film in calcium chloride bath for 2 minutes
    c. Place film back onto the petri dish
    d. Dry the sodium alginate films again in the oven at 60°C for 24 hours

Conclusions/action items:

Some team members will have to come tomorrow to complete the fabrication.

SIMON FETHERSTON - Mar 19, 2026, 11:04 AM CDT

Follow up to initial fabrication:

The two dishes were put in the oven for 8 hours at 50C. One dish was covered and the other was was left uncovered. both dishes seemed to melt and then resolidify. They were left for 24 hours at room temperature to resolidify. The gel that was uncovered evaporated much more water and is stronger.

03/19/2026 Alginate Film First Attempt

SIMON FETHERSTON - Mar 19, 2026, 11:29 AM CDT

Title: Gelatin and Sodium Alginate Film Fabrication

Date: 2026/03/18

Content by: Simon Fetherston

Present: Evelyn, Simon, Mariah

Goals: Make a first run of gelatin film, so we can present it at show and tell.

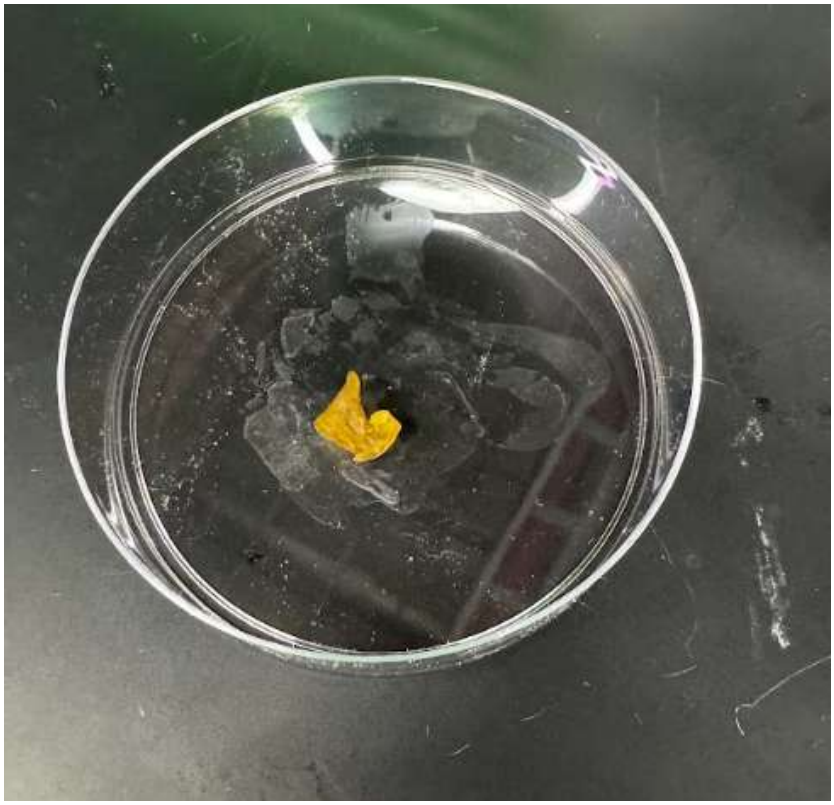
Content:

Fabrication protocol

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare dissolved sodium alginate solution
    1. Using a serological pipette, add 80mL of distilled water to 100mL beaker
    2. Place beaker with water onto a hot plate set to 60 ± 0.5 °C to heat water for about 8-10 minutes
    3. Zero a weigh boat using scale
    4. Measure 1.6 g (2% w/v) sodium alginate (Keltone LVCR) in the weight boat using a scoopula [1]
    5. Transfer sodium alginate powder to 100 mL beaker
    6. Pour warmed water into 100mL beaker
    7. Place 100 mL beaker with sodium alginate powder powder on heated hot plate in a fume hood
    8. Add 0.634 mL of glycerin into beaker with sodium alginate solution
    9. Place a magnetic stir into the 100mL beaker:
        1. Set hot plate to 60 ± 0.5 °C
        2. Set magnetic stir to a medium-low speed (~400 rpm)
        3. Leave to stir for 1 hour
    10. After 1 hour, pour mixture into a petri dish
    11. Place the petri dish with mixture in a drying oven set to 60°C for 24 hours to form film
3. Prepare 0.8 M calcium chloride crosslinking solution
    1. Zero a small weigh boat using scale
    2. Measure 11.76 g of calcium chloride into the weigh boat using a scoopula [1]
    3. Transfer calcium chloride to a 400mL beaker
    4. Place 400 mL beaker with calcium chloride powder on a hot plate in a fume hood
    5. Using a serological pipette, add 100 mL of distilled water to 400 mL beaker
    6. Place magnetic stir into the 400 mL beaker and turn on hot plate:
        1. Set magnetic stir to a medium-low speed (~400 rpm)
        2. Leave to stir for 15 minutes

4. Immerse sodium alginate film in calcium chloride solution
    1. Remove sodium alginate film from oven and remove the film from the petri dish
    2. Submerge sodium alginate film in calcium chloride bath for 2 minutes
    3. Place film back onto the petri dish
    4. Dry the sodium alginate films again in the oven at 60°C for 24 hours

Test 1: This sodium alginate was made in accordance to the fabrication protocol. The petri dish was covered in the oven. After 24 hours, the film was solid in the middle but wet around the outsides. A small, circular portion was cut out and the gel was submerged in calcium chloride. It formed an initial crosslink and was then placed in the oven. After 24 hours, the film was shriveled as shown below.



Test 2: 3 more films were made of 20mL and one of 10mL. These films were uncovered. After 24 hours, they were completely evaporated.

Conclusions/action items: This initial fabrication will help to create more sodium alginate films. Since the oven may fluctuate temperature, covering the dishes for long and heating at a higher or longer temp may help solidify the full film. Also, after submerging the film, it could be washed with DI water and left at room temp to air dry rather than put it in the oven.

03/25/2026 Gelatin Less Water

Evelyn Mikkelson - Mar 26, 2026, 11:47 AM CDT

Title: Gelatin with Less Water

Date: 2026/03/25

Content by: Evelyn Mikkelson

Present: Evelyn, Simon, Mariah, Yeanne

Goals: Make gelatin with less water to see if we can get better properties.

Content:

***Past gelatin samples were all molded so they were thrown away

Procedure 2:

1. Setup fume hood for use
    a. See instructions on the fume hood for proper setup
2. Prepare gelatin powder
    a. Zero a small weigh boat using scale
    b. Measure 20 g of 300 g bloom porcine gelatin in the weigh boat using a scoopula [1] **- after seeing how much 20g of gelatin we decided to use 5g**
    c. Transfer gelatin powder to 100 mL beaker
3. Place 100 mL beaker with gelatin powder on a hot plate in a fume hood
4. Using a 25 mL serological pipette, add 40 mL of deionized water to the beaker **- we used 40mL of water instead**
5. Place magnetic stir bar and turn on hot plate **- stirred water and gelatin before applying heat**
    a. Set magnetic stir to a medium-low speed (~400 rpm)
    b. Set temperature to 50°C
6. Add glycerin to beaker at a ratio of 20% weight relative to the mass of gelatin used
    a. For this application, use 3.17 mL of glycerin **- with gelatin at 5g, use 0.8mL**
    b. Measure 3.17 mL of glycerin and add to beaker using 1 mL serological pipette
7. Allow gelatin-glycerin solution to mix for 30 minutes at 50°C to ensure homogenous solution
8. Transfer 10 mL of mixed solution to petri dish using 25mL serological pipette
9. Allow solution to solidify at room temperature for 12 hours **- was mostly evaporated, left hard film on bottom of dish**

Conclusions/action items:

Continue trying different ratios and drying methods to get correct properties of gelatin.

04/06/2026 Thicker gelatin film + Initial Mold

SIMON FETHERSTON - Apr 08, 2026, 12:19 PM CDT

Title: Gelatin with Less Water

Date: 2026/03/25

Content by: Simon

Present: Simon, Mariah

Goals: Make gelatin with less water put pour a larger amount into molds

Content:

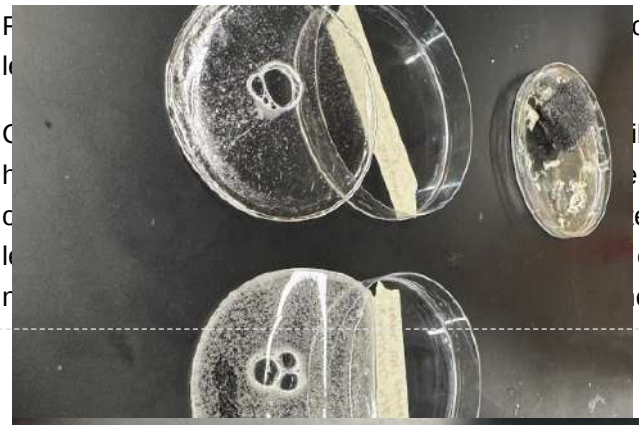
Procedure 2:

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare gelatin powder
    1. Zero a small weigh boat using scale
    2. Measure 10 g of 300 g bloom porcine gelatin in the weigh boat using a scoopula [1]
    3. Transfer gelatin powder to 100 mL beaker
3. Place 100 mL beaker with gelatin powder on a hot plate in a fume hood
4. Using a 25 mL serological pipette, add 80 mL of deionized water to the beaker - gelatin and water mixed much better and did not instantly solidify
5. Place magnetic stir bar and turn on hot plate - stirred water and gelatin before applying heat
    1. Set magnetic stir to a medium-low speed (~400 rpm)
    2. Set temperature to 50°C
6. Add glycerin to beaker at a ratio of 20% weight relative to the mass of gelatin used
    1. For this application, use 1.6 mL
    2. Measure 1.6 mL of glycerin and add to beaker using 1 mL serological pipette
7. Allow gelatin-glycerin solution to mix for 30 minutes at 50°C to ensure homogenous solution
8. Transfer 20 mL of mixed solution to petri dish using 25mL serological pipette - one petri dish was sprayed with DuPont Teflon Silicone Lubricant Aerosol Spray

    - Excess of gelatin solution was placed in a petri dish. A small sponge was cut out and placed in the solution. The sponge was squeezed and held together until the gelatin solidified and held its shape. There were then 3 petri dishes with 20 mL of gelatin solution (covered, uncovered, uncovered with silicone spray)
9. Allow solution to solidify at room temperature for 12 hours

SIMON FETHERSTON - Apr 08, 2026, 12:31 PM CDT

F one. (Middle) Gelatin sample left covered. (Bottom) Gelatin sample l



C ill allow for degradation testing. The covered gelatin remained a h . Also, the uncovered gelatin film on the bottom is strong and free o eria and can be used as a packaging material. While the gelatin l evaporation, it is a promising proof of concept that the gelatin will r e material will be applied and testing can begin.

SIMON FETHERSTON - Apr 13, 2026, 12:20 PM CDT

The gelatin hydrogel was wrapped around the sponge and placed in the 2.5 cm mold. The device was left in the fridge for 48 hours. After removing the sponge from the mold, there was clearly a decrease in diameter of the sponge. The gelatin was also firm and stayed together, felt smooth to the touch.

04/10/2026 Gelatin For Degradation Testing

Evelyn Mikkelson - Apr 10, 2026, 12:32 PM CDT

Title: Gelatin for Degradation Testing

Date: 2026/04/10

Content by: Evelyn

Present: Simon, Mariah, Evelyn, Yeanne

Goals: Make gelatin for degradation testing.

Content:

Procedure 2:

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare gelatin powder
    1. Zero a small weigh boat using scale
    2. Measure 10 g of 300 g bloom porcine gelatin in the weigh boat using a scoopula [1] **- 5g**
    3. Transfer gelatin powder to 100 mL beaker
3. Place 100 mL beaker with gelatin powder on a hot plate in a fume hood
4. Using a 25 mL serological pipette, add 80 mL of deionized water to the beaker - gelatin and water mixed much better and did not instantly solidify **- used 40mL**
5. Place magnetic stir bar and turn on hot plate - stirred water and gelatin before applying heat
    1. Set magnetic stir to a medium-low speed (~400 rpm)
    2. Set temperature to 50°C
6. Add glycerin to beaker at a ratio of 20% weight relative to the mass of gelatin used
    1. For this application, use 1.6 mL **- 0.8mL**
    2. Measure 1.6 mL of glycerin and add to beaker using 1 mL serological pipette
7. Allow gelatin-glycerin solution to mix for 30 minutes at 50°C to ensure homogenous solution
8. Transfer 20 mL of mixed solution to petri dish using 25mL serological pipette - one petri dish was sprayed with DuPont Teflon Silicone Lubricant Aerosol Spray

    - Excess of gelatin solution was placed in a petri dish. A small sponge was cut out and placed in the solution. The sponge was squeezed and held together until the gelatin solidified and held its shape. There were then 3 petri dishes with 20 mL of gelatin solution (covered, uncovered, uncovered with silicone spray)
9. Allow solution to solidify at room temperature for 12 hours

04/10/2026 Gelatin For Sponge Mold

SIMON FETHERSTON - Apr 13, 2026, 12:57 PM CDT

Title: Gelatin for Degradation Testing

Date:04/13/2026

Content by: Evelyn

Present: Simon, Mariah, Evelyn, Yeanne

Goals: Make gelatin sheet to use for sponge molds

Content:

Procedure 2:

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare gelatin powder
    1. Zero a small weigh boat using scale
    2. Measure 16 g of 300 g bloom porcine gelatin in the weigh boat using a scoopula [1] - 16.004g
    3. Transfer gelatin powder to 400 mL beaker
3. Place 400 mL beaker with gelatin powder on a hot plate in a fume hood
4. Using a 25 mL serological pipette, add 128 mL of deionized water to the beaker - added water in a 8:1 ratio to gelatin
5. Place magnetic stir bar and turn on hot plate - stirred water and gelatin before applying heat
    1. Set magnetic stir to a medium-low speed (~400 rpm)
    2. Set temperature to 50°C
6. Add glycerin to beaker at a ratio of 20% weight relative to the mass of gelatin used
    1. For this application, use 2.54 mL (16g*20%/1.26(g/mL))
    2. Measure 2.54 mL of glycerin and add to beaker using 1 mL serological pipette
7. Allow gelatin-glycerin solution to mix for 30 minutes at 50°C to ensure homogenous solution
8. Transfer all of mixed solution to 25 cm x 25 cm Corning bioassay dish
9. Allow solution to solidify, covered, at room temperature for at least 12 hours

04/15/2026 Creating Gelatin Sponge Prototype

SIMON FETHERSTON - Apr 15, 2026, 1:23 PM CDT

Title: Creating Gelatin Sponge Prototype

Date: 04/15/2026

Content by: Simon

Present: Simon, Mariah, Evelyn

Goals: Fabricate complete prototypes

Content:

Steps:

1. Gathered 1.5 cm and 2.5 cm diameter molds

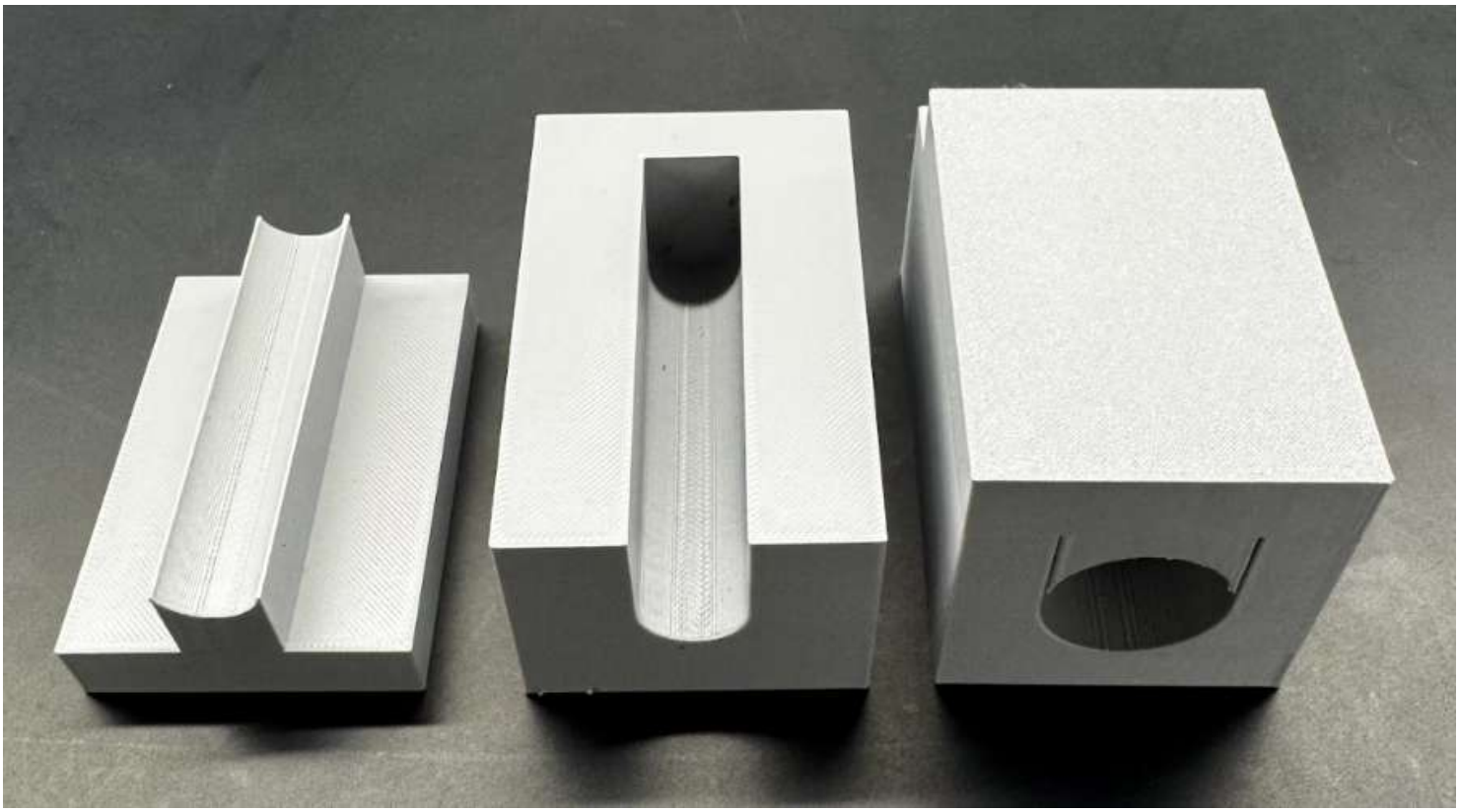


Figure 1: (Left and Middle) 1.5 cm gelatin mold. (Right) 2.5 cm gelatin mold.

2. Create sponge-tube system. First, cut the sponge to a 3 cm diameter, and cut the edges of the sponge down the length of the sponge to create a rounded shape. Second, use the surgical scissors to cut a hole through the center of the sponge. Third, push the tube through the hole in the sponge until all of the feeding holes are covered. Finally, use a suture to tie the tube to the sponge.

Figure 2. Sponge-tube system assembled and is prepared to be sutured together.

3. Cut the gelatin into a 7 cm by 10 cm rectangle.

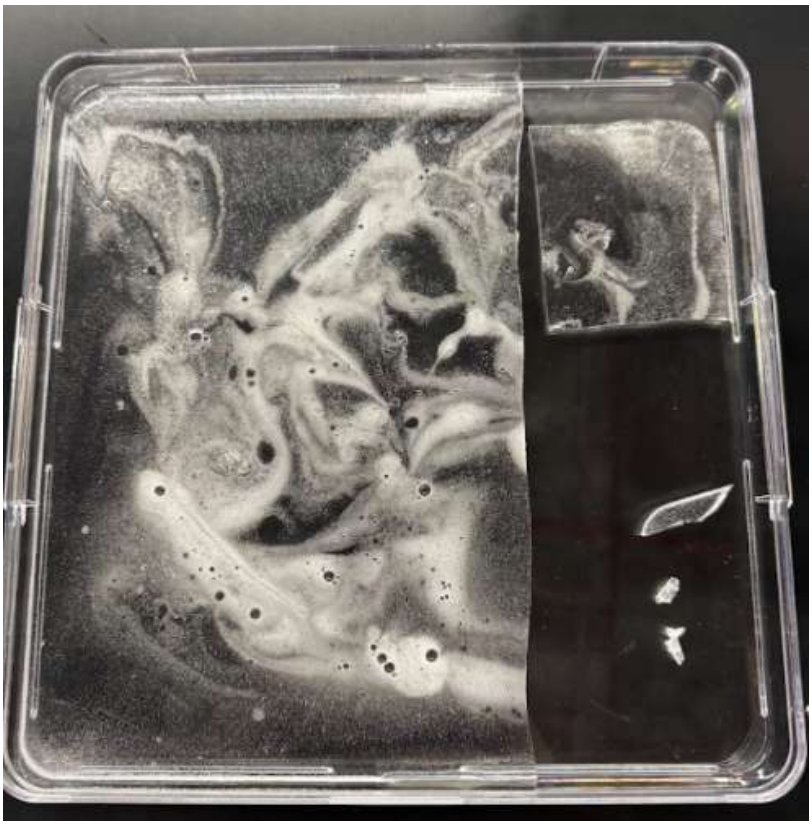


Figure 3. 25 cm by 25 cm gelatin sheet used to encapsulate sponge.

4. Assemble sponge and gelatin in the mold. First, place the gelatin in the bottom mold. Second, manually squeeze the sponge and push it in between the gelatin. Third, use the top mold piece to compress the gelatin and sponge. Fourth, tape the top and bottom mold pieces together so the sponge remains compressed. Place the mold in the oven at 50 C for 5-10 minutes until gelatin is softened. Finally, place the mold in the fridge to solidify.

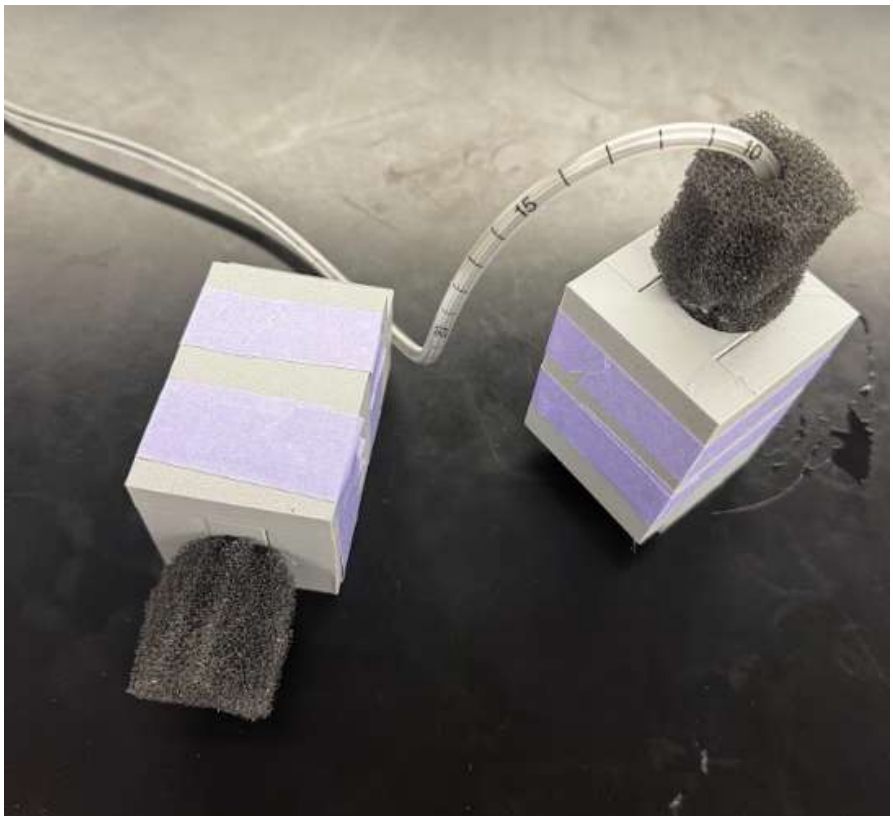


Figure 4. Compete sponge compression molds for 1.5 cm and 2.5 cm diameter molds.

Conclusions/action items: This mold process worked well. The molds are currently in the fridge solidifying. Based on preliminary fabrication, these designs will work well. After they are removed, the diameter can be assessed to determine the effective compression.

04/15/2026 Sodium Alginate For Sponge

Evelyn Mikkelson - Apr 16, 2026, 1:44 PM CDT

Title Sodium Alginate for Sponge

Date: 2026/04/15

Content by: Evelyn

Present: Simon, Mariah, Evelyn, Yeanne

Goals: Make alginate to coat sponge

Content:

Fabrication protocol

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare dissolved sodium alginate solution
    1. Using a serological pipette, add 80mL of distilled water to 100mL beaker
    2. Place beaker with water onto a hot plate set to 60 ± 0.5 °C to heat water for about 8-10 minutes
    3. Zero a weigh boat using scale
    4. Measure 1.6 g (2% w/v) sodium alginate (Keltone LVCR) in the weight boat using a scoopula [1] **- used exactly 1.600g**
    5. Transfer sodium alginate powder to 100 mL beaker
    6. Pour warmed water into 100mL beaker
    7. Place 100 mL beaker with sodium alginate powder powder on heated hot plate in a fume hood **- used 400mL beaker for faster stirring**
    8. Add 0.634 mL of glycerin into beaker with sodium alginate solution **- add stir bar here and wait until mostly combined, used 500rpm**
    9. Place a magnetic stir into the 100mL beaker:
        1. Set hot plate to 60 ± 0.5 °C
        2. Set magnetic stir to a medium-low speed (~400 rpm)
        3. Leave to stir for 1 hour
    10. After 1 hour, pour mixture into a petri dish **- 45mL in 150mm dish, 20mL in 100mm dish, remaining in 100mm dish**
    11. Place the petri dish with mixture in a drying oven set to 60°C for 24 hours to form film **- uncovered**
3. Prepare 0.8 M calcium chloride crosslinking solution **- made crosslinking solution in last fabrication**
    1. Zero a small weigh boat using scale
    2. Measure 11.76 g of calcium chloride into the weigh boat using a scoopula [1]
    3. Transfer calcium chloride to a 400mL beaker
    4. Place 400 mL beaker with calcium chloride powder on a hot plate in a fume hood
    5. Using a serological pipette, add 100 mL of distilled water to 400 mL beaker
    6. Place magnetic stir into the 400 mL beaker and turn on hot plate:

    1. Set magnetic stir to a medium-low speed (~400 rpm)
    2. Leave to stir for 15 minutes
4. Immerse sodium alginate film in calcium chloride solution **- did not crosslink**
    1. Remove sodium alginate film from oven and remove the film from the petri dish
    2. Submerge sodium alginate film in calcium chloride bath for 2 minutes
    3. Place film back onto the petri dish
    4. Dry the sodium alginate films again in the oven at 60°C for 24 hours

Conclusions/action items: Stay tuned.

Evelyn Mikkelson - Apr 16, 2026, 1:44 PM CDT

Title: Sodium Alginate Check In

Date: 2026/04/16

Content by: Evelyn

Present: Evelyn

Goals: Make sure alginate hasn't evaporated and take it out if gel like.

Content:

Sample Status

- ~ 9:45am took them out so they were in oven (36deg C) for 15 hours

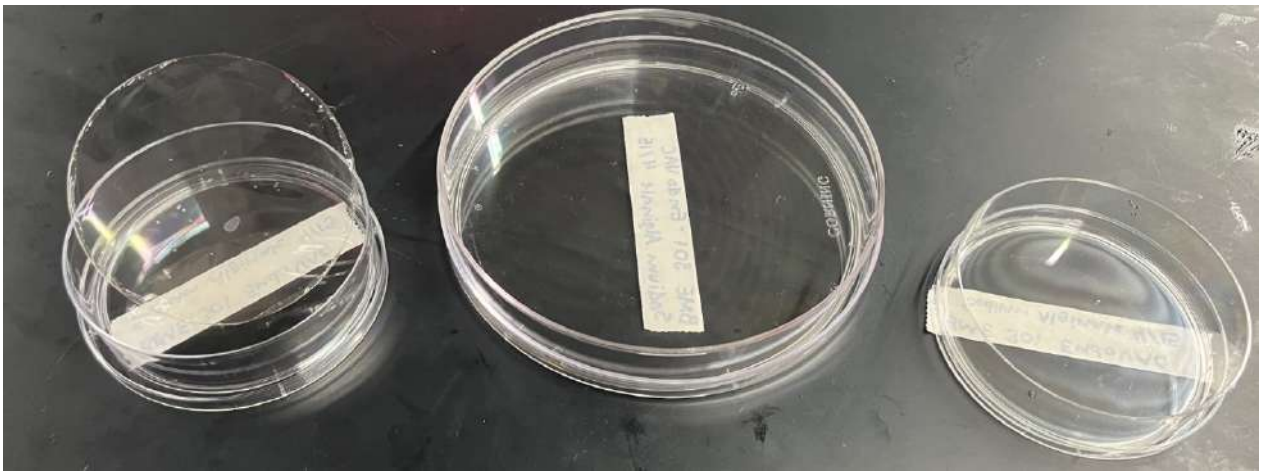


Figure 1. All samples after being removed from the oven. The large dish (middle) and small dish (right) have completely evaporated, but the small dish (left) had a thin film layer on the bottom that was easily peeled off with a tweezers. I assume the dish with film had more solution in it than the others so the film remained.

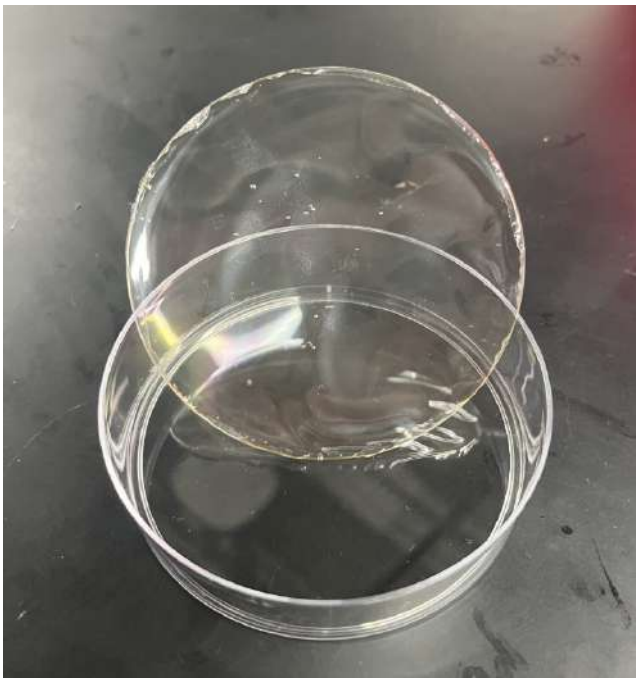


Figure 2. Sodium alginate film. The film is clear with a small amount of bubbles in it. It seems thinner and more flexible than the gelatin film sample was.

Conclusions/action items: This was a surprising find as past sodium alginates either evaporated or remained in a gel or liquid. If we are going to try this last minute I think we should have it drying during the day so we can check on it, and prevent the evaporation. Additionally, the oven might have to be at a higher temperature to speed drying to accommodate us being able to check it.

04/16/2026 Sodium Alginate Film

Evelyn Mikkelson - Apr 16, 2026, 1:55 PM CDT

Title Sodium Alginate Film

Date: 2026/04/16

Content by: Evelyn

Present: Simon, Mariah, Evelyn, Yeanne

Goals: Make alginate film to potentially seal sponge.

Content:

Fabrication protocol

1. Setup fume hood for use
    1. See instructions on the fume hood for proper setup
2. Prepare dissolved sodium alginate solution
    1. Using a serological pipette, add 80mL of distilled water to 100mL beaker
    2. Place beaker with water onto a hot plate set to 60 ± 0.5 °C to heat water for about 8-10 minutes - **hotter to make it dry faster**
    3. Zero a weigh boat using scale
    4. Measure 1.6 g (2% w/v) sodium alginate (Keltone LVCR) in the weight boat using a scoopula [1] **- used 1.611g**
    5. Transfer sodium alginate powder to 100 mL beaker
    6. Pour warmed water into 100mL beaker
    7. Place 100 mL beaker with sodium alginate powder powder on heated hot plate in a fume hood **- used 400mL beaker for faster stirring**
    8. Add 0.634 mL of glycerin into beaker with sodium alginate solution **- add stir bar here and wait until mostly combined, used 500rpm**
    9. Place a magnetic stir into the 100mL beaker:
        1. Set hot plate to 60 ± 0.5 °C
        2. Set magnetic stir to a medium-low speed (~400 rpm)
        3. Leave to stir for 1 hour
    10. After 1 hour, pour mixture into a petri dish **- all in 150mm dish**

11. Place the petri dish with mixture in a drying oven set to 60°C for 24 hours to form film **- uncovered, I will be checking in every couple of hours to make sure it hasn't evaporated**

Conclusions/action items: Stay tuned.

Evelyn Mikkelson - Apr 17, 2026, 7:03 PM CDT

Title: Sodium Alginate Results

Date: 2026/04/17

Content by: Evelyn

Present: Evelyn

Goals: Check in on alginate and take out if film.

Content:

Sample Status

- Turned down temperature to 40 at 5:10 (after ~1 hour and 20 minutes) because it was close to being a film
  - It was sticky
- Took out at 6:30 (~1 hour and 20 minutes after turning down temperature) and let it sit out uncovered
  - Still sticky
- Came back at 12:00 the next day (sat out for ~7 hours and 30 minutes) and was not able to pull out (still sticky)
- Put in oven for 15 minutes at 40 to dry out further then out of caution pulled out the film

Figure 1. Film as I was taking it out of the dish. It was very strong and withstood me pulling it out with a tweezers. There are some spots where it got stuck, but I think that is where the last alginate did not evaporate. Additionally, it did not dry evenly so some spots were still gel.

- After taking film out I put it back in oven at 40 to try to thin it, but it almost seemed to come our harder, but got more flexible as it was flexed

Conclusions/action items: This film seems to have similar properties to the last one, but it is thicker. I think the thickness makes it less bendy. If this is made again next semester it should be started in the morning so there can be periodic check ins until the film is thin and flexible. We will also have to brainstorm ways to put this on a compressed sponge.

04/19/2026 Sodium Alginate Film Over Sponge

Evelyn Mikkelson - Apr 19, 2026, 3:57 PM CDT

Title Sodium Alginate Film Over Sponge

Date: 2026/04/18

Content by: Evelyn

Present: Mariah, Evelyn

Goals: Try to seal sponge with sodium alginate using 1.5cm mold.

Content:

1. 3cm sponge was sutured onto nasogastric tube
2. Sodium alginate film was dipped in PBS
3. Sponge was wrapped in sodium alginate and put into mold
4. Sponge was compressed using top piece and top piece secured using tape
5. It was set out to dry

Conclusions/action items: Stay tuned.

04/22/2026 Final Gelatin Prototype

SIMON FETHERSTON - Apr 28, 2026, 5:55 PM CDT

Title: Gelatin Prototype for Poster Presentation

Date: 04/22/2026

Content by: Simon

Present: Simon

Goals: Create a final product for poster presentation

Content:

Using a 150 mm petri dish to make gelatin hydrogel

Following 1:8 ratio of gelatin to DI water as stated in previous fabrications. Following fabrication protocols used for gelatin film fabrication.

Using 5.625 g gelatin, 45 mL DI water, and 0.9 mL glycerin

Figure 1. Final device prototype using gelatin film.

The final device is 7.0 cm in length and has a diameter of 1.5 cm. This size fits the design criteria as the final diameter is smaller than the 2.0 cm maximum. The nasogastric tube allows for negative pressure to be applied to the sponge after insertion into the esophageal cavity.

Conclusions/action items: The final prototype worked and was demonstrated at the final poster presentation. The gelatin film remained stable during the duration of the poster session. Testing and results show that the gelatin film quickly melts and degrades at body temp. The future of the project will likely involve mimicking the final sponge design with sodium alginate or a material that has degradation properties closer to the design criteria.

03/06/2026 Placement Testing

SIMON FETHERSTON - Mar 06, 2026, 11:35 AM CST

Title: Placement Testing Protocol

Date: 03/06/2026

Content by: Team

Present: Team

Goals: Create a testing protocol to test the time required to place the device within a cavity

Content:

Placement Testing Protocol

Objective: Measure the time it takes to place the device within a model gastrointestinal tract.

Materials:

- 3 degradable coating prototypes
    - Sponge
    - Drainage tube
    - Degradable coating
- 3 sponges of 2cm, 4cm, and 6cm diameters
- Model esophagus
- Timer

Procedure:

1. Assemble device with sponge and degradable coating
2. Start timer
3. Insert device orally into model esophagus cavity
4. Navigate gastrointestinal model to place sponge into the cavity
5. Stop timer when the sponge is fully within the cavity
6. Record total time elapsed for placement procedure
7. Repeat steps 1-6 for each sponge size 5 times, totaling 15 total trials
    1. Conduct pull-out force test prior to beginning a new trial (Reference Appendix IV)
8. Run ANOVA statistical analysis of mean placement times between the three sponge sizes
9. Run one sample t-test of average placement time between all trials with a null hypothesis of 5 minutes

Conclusions/action items: This is a preliminary protocol for placement testing. The protocol will help guide fabrication as the device should be able to be tested to determine placement time. This protocol will be revised prior to testing and utilized to determine ease of placement for the prototype.

03/06/2026 Mechanical Testing

SIMON FETHERSTON - Mar 06, 2026, 11:40 AM CST

Title: Mechanical Testing Protocol

Date: 03/06/2026

Content by: Team

Present: Team

Goals: Create a testing protocol for the mechanical forces required to remove the device

Content:

Mechanical Testing Protocol

Pull-Out Force

Objective: Measure the force required to remove the device from the gastrointestinal tract.

Materials:

- 3 degradable coating prototypes
    - Sponge
    - Drainage tube
    - Degradable coating
- 3 sponges of 2cm, 4cm, and 6cm diameters
- Model esophagus
- Digital force gauge

Procedure:

1. Perform test in conjunction with placement testing (Reference Appendix III)
2. After device has been implanted from placement test, prepare force gauge
    1. Attach force gauge to end of drainage tube using duct tape
    2. Turn on force gauge
    3. Select peak mode to record maximum force
    4. Zero force gauge
3. Apply force perpendicular to force gauge to remove device from gastrointestinal tract
    1. Ensure constant speed to minimize error of force measurement
4. Record maximum force applied to completely remove device from model
5. Repeat steps 1-4 for each sponge size 5 times, totaling 15 total trials
6. Run ANOVA analysis of the mean maximum force for the increasing size sponges

Conclusions/action items: This mechanical testing protocol will be used to measure the force required to remove the device from the patient. It is likely that there will be large variation on removal force based on experimental errors such as the speed of removal and the position of the cavity. Changes to this protocol will be examined prior to testing to try and limit these errors.

03/06/2026 Expansion/Degradation Testing

SIMON FETHERSTON - Mar 06, 2026, 11:56 AM CST

Title: Degradation Testing Protocol

Date: 03/06/2026

Content by: Team

Present: Team

Goals: Create a testing protocol to measure degradation characteristics

Content:

Degradation Testing

Objective: Measure the degradation of coating to assess device properties in simulated gastrointestinal tract conditions.

Materials:

- 3 sponges of 2cm, 4cm, and 6cm diameters
- Degradable coating
- 500 mL beaker
- Caliper
- Phosphate buffered saline (PBS)
- Porcine esophageal model

Procedure:

1. Record initial diameter of sponge using the caliper
2. Manually compress sponge to smallest possible diameter
3. Apply degradable coating and form a seal
    1. Ensure no air is able to enter sponge and increase sponge diameter
4. Record compressed diameter of sponge using the caliper
5. Prepare 250mL of PBS in a 500mL beaker
6. Submerge compressed sponge within PBS bath until the sponge is completely beneath the surface
7. Let the sponge remain in solution for 3 days
    1. Take intermediate measurements once a day:
        1. Record diameter of the sponge using the caliper
        2. Record qualitative observations regarding the color of the solution and conditions of the degradable coating
8. After 3 days, remove the sponge from the solution and record final diameter of the sponge
9. Calculate percent change between initial and final diameter of the sponge
10. Repeat steps 1-9 for each sponge 5 times, totaling 15 trials
11. Run a t-test of the average percent change with a null hypothesis of 100%
12. Repeat steps 1-11 using the porcine esophageal model

2. Place sponge within esophageal model and continue to step 7

Conclusions/action items: This testing protocol compares the percent change in sponge diameter. A greater percent change is ideal because it means the sponge was held at a small compressed diameter and was able to expand. This expansion is a signal of the degradation of the biomaterial. If the sponge is able to be compressed and then have sustained expansion, it shows the period of degradation for the biomaterial where are and liquid is able to cross the coating barrier.

04/15/2026 Material Only Degradation Testing

Evelyn Mikkelson - Apr 15, 2026, 12:52 PM CDT

Title: Coating Material Degradation Testing Protocol

Date: 04/15/2026

Content by: Team

Present: Team

Goals: Create a testing protocol to measure degradation characteristics of material.

Content:

Coating Material Degradation Testing

Objective: Measure the degradation of coating to assess performance in simulated gastrointestinal tract conditions.

Materials:

- Gelatin samples - 3 per time period
  - Covered and uncovered
- Sodium alginate samples - 3 per time period
- 500 mL beaker
- Phosphate Buffered Saline (PBS) working solution (1X, pH 7.4 ± 0.2)
  - 10X PBS stock solution (pH 7.4, 0.2 µm filtered) diluted 1:9 with DI water

Phosphate buffered saline | Protocols Online

- Constant temperature bath (or oven) at 37°C +/- 1°C
- pH meter
- Temperature probe - we should see if there is any in 1080
- Balance to measure sample mass

Procedure:

1. Preheat incubator and let it reach 37°C
2. Prepare PBS solution: dilute 50 mL of 10X PBS stock into 450 mL distilled water to yield 500 mL of 1X working solution.
3. Divide out 100mL diluted PBS solution to 500mL containers
4. Set all 500mL containers with diluted PBS solution and put in the preheated incubator and leave to warm up for at least 2 hours
5. Weigh each sample prior to being in solution and mark weight
6. Record the initial pH and temperature of PBS solution
7. Immerse 3 samples per 500mL container with PBS solution and record weights at 5, 10, 15, 20, 25, 30, 60, 90 minutes

8. At each time interval, remove samples from PBS, place on a paper towel and blot gently with a second paper towel using consistent pressure (3 blots). Immediately transfer to a tared weighing boat and record mass. Return sample to PBS within 2 minutes of removal.
9. Record the pH and temperature of PBS solution at each interval
10. If at any point the same is completely disintegrated, mark weight as 0g and mark the time it was measured.
11. Repeat steps 1-4 for each time interval

Limitation: Samples were tested in shared containers (3 samples per container) rather than individual vessels. This means that as samples degrade, material released into the PBS solution may alter the local environment over time, potentially affecting the degradation rate of remaining samples within the same container. Ideally, each sample would be tested in its own individual container of fresh PBS to ensure a fully controlled and independent environment for each replicate. Results should be interpreted with this in mind.

Conclusions/action items: This testing protocol compares degradation rates of prospective materials. The team will use this to test samples today. See experimentation folder for notes and data.

04/15/2026 Covered Gelatin Degradation Testing

Evelyn Mikkelson - Apr 15, 2026, 4:02 PM CDT

Title: Covered Gelatin Degradation Testing

Date: 2026/04/15

Content by: Evelyn Mikkelson

Present: Evelyn, Simon, Mariah

Goals: Test the uncovered gelatin degradation to see if it would work well on the sponge.

Content:

Coating Material Degradation Testing
Objective: Measure the degradation of coating to assess performance in simulated gastrointestinal tract conditions.
Materials:

- Gelatin samples - 3 samples per time period - **used same 6 samples for all time periods**
  - Covered and uncovered
- Sodium alginate samples - 3 per time period
- 500 mL beaker - **used 6 50mL beakers, one per sample to keep them separate**
- Phosphate Buffered Saline (PBS) working solution (1X, pH 7.4 ± 0.2)
  - 10X PBS stock solution (pH 7.4, 0.2 µm filtered) diluted 1:9 with DI water

Phosphate buffered saline | Protocols Online

- Constant temperature bath (or oven) at 37°C +/- 1°C - **put into incubator**
- pH meter - **used pH strips**
- Temperature probe
- Balance to measure sample mass

Procedure:

1. Preheat incubator and let it reach 37°C
2. Prepare PBS solution: dilute 50 mL of 10X PBS stock into 450 mL distilled water to yield 500 mL of 1X working solution.
3. Divide out 100mL diluted PBS solution to 500mL containers - **each 50mL beaker has 20mL PBS solution by serological pipette**
4. Set all 500mL containers with diluted PBS solution and put in the preheated incubator and leave to warm up for at least 2 hours - **took overnight**
5. Weigh each sample prior to being in solution and mark weight
6. Record the initial pH and temperature of PBS solution
7. Immerse 3 samples per 500mL container with PBS solution and record weights at 5, 10, 15, 20, 25, 30, 60, 90 minutes - **had one sample per container**
8. At each time interval, remove samples from PBS, place on a paper towel and blot gently with a second paper towel using consistent pressure (3 blots). Immediately transfer to a tared weighing boat and record mass. Return sample to PBS within 2 minutes of removal. - **covered gelatin was dissolved within 5 minutes, had to gather gel parts with scoop wipe on Kimwipe, the scale was zeroed with the weigh boat and the dry Kimwipe on it**
9. Record the pH and temperature of PBS solution at each interval - **recorded in 15 minute intervals**
10. If at any point the same is completely disintegrated, mark weight as 0g and mark the time it was measured. - **5 min was the only one with measurement**
11. Repeat steps 1-4 for each time interval

0 Minutes

Figure 1. Covered gelatin samples before being put into solution

5 Minutes

1. 0.049g
2. 0.051g
3. 0.037g
4. 0.088g
5. 0.072g
6. 0.081g

10 Minutes

- The samples were dissolved in solution
- pH = 7 was recorded

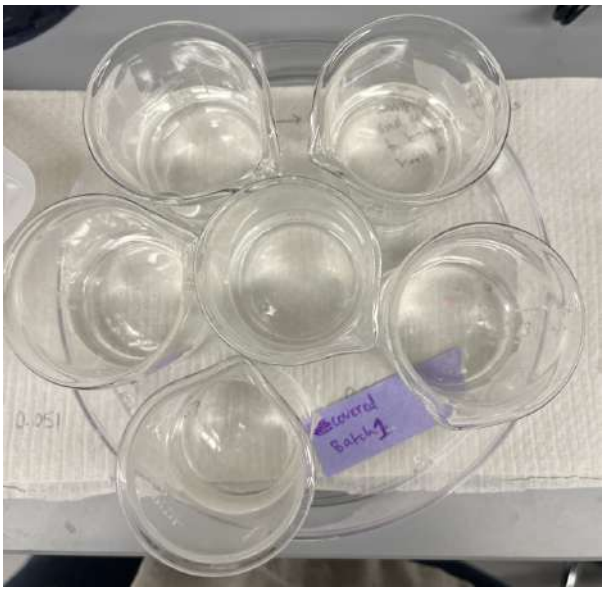


Figure 2. Covered gelatin samples dissolved after 10 minutes.

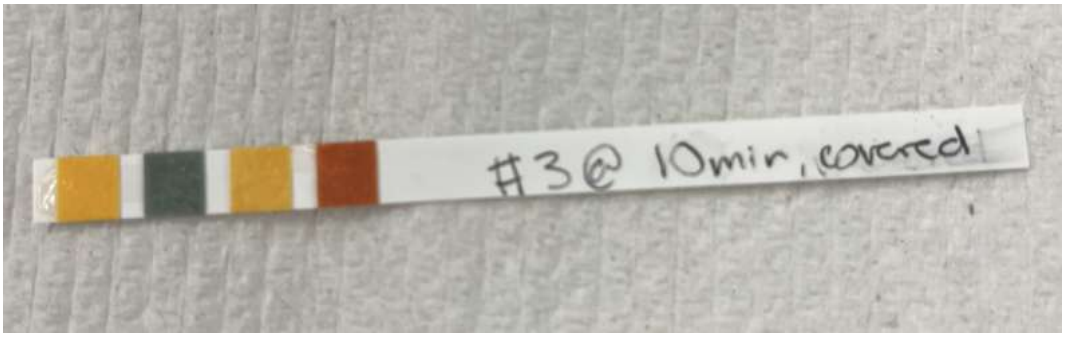


Figure 3. pH strip of sample #3 after ten minutes. The pH stayed at 7.

Shorter Time Trials

- Simon later tried to perform testing at shorter time intervals to get a degradation profile, but even at 30s it was almost dissolved

Conclusions/action items:

Sample 6 was weighed first working down to sample 1 being weighed last. The longer the solution was out of the incubator the more it cooled and gelatin began reforming a gel layer on the bottom. Once scooped out of solution, the samples were not able to be dried. These errors could be why there are a range of readings. After 10 minutes there was no gel left to scoop out so the measurements will all be zeroed from that time point forward. The protocol will be updated to match.

04/19/2026 Gelatin Sponge Expansion Testing

Evelyn Mikkelson - Apr 19, 2026, 3:53 PM CDT

Title: Sponge Expansion Testing

Date: 2026/04/19

Content by: Evelyn Mikkelson

Present: Evelyn, Simon, Mariah, Yeanne

Goals: See how long it takes for the sponge to expand.

Content:

Sponge Expansion Testing
Objective: Measure the expansion of the sponge to assess device properties in simulated gastrointestinal tract conditions.

Materials:

- 3 sponges of 2cm, 4cm, and 6cm diameters
- Degradable coating
- 500 mL beaker **- 400mL beakers**
- Caliper
- Phosphate buffered saline (PBS)

Phosphate buffered saline | Protocols Online

- Porcine esophageal model

Procedure:

1. Record initial diameter of sponge using the caliper
2. Manually compress sponge to smallest possible diameter
3. Apply degradable coating and form a seal
    a. Ensure no air is able to enter sponge and increase sponge diameter
4. Record compressed diameter of sponge using the caliper **- fabricated 6 sponges original size 3cm compressed to 1.5cm, they were left out so the gelatin has dried to a film and the sponges are now hard**
5. Prepare 250mL of PBS in a 500mL beaker **- will need 400mL per to submerge sponge**

Figure 1. Testing set up without PBS.

1. Let the sponge remain in solution for 3 days **- it did not take this long, will be recording video to grab screenshots and use ImageJ to get diameters - have to use hotplates with whiteboard backdrop because clear incubator is unavailable - using tripods to record with 1 phone per sponge - had stir bars at 100rpm (low to avoid it moving sponge and tape to hold sticks to beakers) - hot plates at 50 to prevent cooling - had recordings on time lapse and back calculated time passed - screenshots every 1 minute**
    a. Take intermediate measurements once a day:
        i. Record diameter of the sponge using the caliper
        ii. Record qualitative observations regarding the color of the solution and conditions of the degradable coating
2. After 3 days, remove the sponge from the solution and record final diameter of the sponge
3. Calculate percent change between initial and final diameter of the sponge
4. Repeat steps 1-9 for each sponge 5 times, totaling 15 trials
5. Run a t-test of the average percent change with a null hypothesis of 100% expansion to original diameter.
6. Repeat steps 1-11 using the porcine esophageal model **- do not have, skipped**
    a. Replace the 250mL PBS in the 500mL in step 5 beaker with the porcine esophageal model
    b. Place sponge within esophageal model and continue to step 7

Observations

- Gelatin held onto the back of the sponges
- Sponges expanded unequally, likely from uneven coating of gelatin

Conclusions/action items:

Take screenshots from video and upload to drive by tonight.

04/29/2026 Experimentation Analysis Code

SIMON FETHERSTON - Apr 29, 2026, 9:40 PM CDT

Title: Experimentation Analysis Code

Date: 04/29/2026

Content by: Simon

Present: Simon

Goals: Display code used for experimentation analysis

Content:

1. **Uncovered Gelatin Degradation Initial Mass Variance Plot**

```
%% Degradation Analysis - Uncovered Gelatin Film
clc; clear; close all;
%% DATA ENTRY
time = [0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 60, 90, 100];
all_initial_mass = [0.36, 0.33, 0.33, 0.35, 0.32, 0.31];
raw_mass = [
  0.36,  0.33,  0.33,  0.35,  0.32,  0.31;
  0.60,  0.62,  0.617, 0.60,  0.60,  0.59;
  0.72,  0.67,  0.687, 0.70,  0.68,  0.72;
  0.78,  0.758, 0.84,  0.74,  0.80,  0.80;
  0.94,  0.867, 0.91,  0.89,  0.88,  0.894;
  1.034, 0.92,  1.03,  0.977, 0.944, 0.95;
  1.102, 1.014, 1.117, 1.08,  1.031, 1.057;
  1.22,  1.06,  1.16,  1.167, 1.08,  1.10;
  1.27,  1.18,  1.23,  1.166, 1.15,  1.104;
  1.30,  1.22,  1.32,  1.18,  1.168, 1.11;
  1.43,  1.32,  1.42,  1.46,  1.41,  1.29;
  0.30,  0.47,  0.18,  0.10,  0.30,  0.13;
  0,     0,     0,     0,     0,     0;
];
%% STATISTICS
mean_mass = mean(raw_mass, 2);
sd_mass   = std(raw_mass, 0, 2);
pct_individual = (raw_mass ./ raw_mass(1,:)) * 100;
pct_remaining  = mean(pct_individual, 2);
pct_sd         = std(pct_individual, 0, 2);
```

```
%% PEAK SWELLING
[peak_pct, peak_idx] = max(pct_remaining);
peak_time = time(peak_idx);
fprintf('Uncovered Gelatin -Results \n');
fprintf('Initial mean mass:          %.3f g\n', mean_mass(1));
fprintf('SD of initial mass:         %.3f g (%.1f%% of mean)\n', ...
  sd_mass(1), (sd_mass(1)/mean_mass(1))*100);
fprintf('Peak swelling:              %.1f%% at t = %d min\n', peak_pct, peak_time);
fprintf('Complete dissolution:       between 90 and 100 min\n\n');
%% LINEAR FIT (dissolution phase: 60-100 min)
diss_mask  = time >= peak_time;
time_diss  = time(diss_mask);
pct_diss   = pct_remaining(diss_mask);
p_lin = polyfit(time_diss, pct_diss, 1);
slope_val = p_lin(1);
intercept = p_lin(2);
pct_fit_pts = polyval(p_lin, time_diss);
ss_res = sum((pct_diss - pct_fit_pts).^2);
ss_tot = sum((pct_diss - mean(pct_diss)).^2);
r_sq   = 1 - ss_res / ss_tot;
t_zero = -intercept / slope_val;
fprintf(' Linear Fit (60-100 min)\n');
fprintf('Slope:                      %.3f %%/min\n', slope_val);
fprintf('R-squared:                  %.3f\n', r_sq);
fprintf('Extrapolated t = 0%%:       %.1f min\n\n', t_zero);
t_fit_range = linspace(peak_time, t_zero, 300);
pct_fit     = polyval(p_lin, t_fit_range);
pct_fit(pct_fit < 0) = 0;
%% FIGURE 1 - Full degradation curve
figure('Name', 'Uncovered Gelatin Degradation', 'Position', [100 100 850 540]);
hold on;
y_max = max(pct_remaining + pct_sd) + 20;
patch([0, peak_time, peak_time, 0], [0, 0, y_max, y_max], ...
  [0.8 0.9 1.0], 'FaceAlpha', 0.2, 'EdgeColor', 'none', ...
  'DisplayName', 'Swelling phase');
patch([peak_time, 103, 103, peak_time], [0, 0, y_max, y_max], ...
```

```
    [1.0 0.85 0.85], 'FaceAlpha', 0.2, 'EdgeColor', 'none', ...
    'DisplayName', 'Dissolution phase');
x_band = [time, fliplr(time)];
y_band = [pct_remaining' + pct_sd', fliplr(pct_remaining' - pct_sd')];
fill(x_band, y_band, [0.85 0.85 0.85], 'FaceAlpha', 0.4, ...
    'EdgeColor', 'none', 'DisplayName', '\pm 1 SD band');
errorbar(time, pct_remaining, pct_sd, 'ko-', ...
    'LineWidth', 2, 'MarkerSize', 7, 'MarkerFaceColor', 'k', ...
    'CapSize', 6, 'DisplayName', 'Mean \pm SD (n=6)');
plot(t_fit_range, pct_fit, 'r--', 'LineWidth', 2, ...
    'DisplayName', 'Linear fit (dissolution phase)');
plot(peak_time, peak_pct, 'b^', 'MarkerSize', 10, 'MarkerFaceColor', 'b', ...
    'DisplayName', sprintf('Peak swelling (%d min)', peak_time));
yline(100, 'k:', 'LineWidth', 1, 'DisplayName', 'Initial mass (100%)');
text(t_zero - 1, 18, ['Slope = ' sprintf('%.1f', slope_val) ' %/min'], ...
    'FontSize', 9, 'FontName', 'Arial', 'Color', 'r', ...
    'HorizontalAlignment', 'right');
hold off;
xlabel('Time (min)', 'FontSize', 12);
ylabel('Mass remaining relative to t=0 (%)', 'FontSize', 12);
title('Uncovered Gelatin Film — Swelling and Dissolution in PBS (pH 7.4, 37°C)', ...
    'FontSize', 13);
legend('Location', 'northeast', 'FontSize', 9);
xlim([-2 103]);
ylim([0 y_max]);
grid on; box on;
set(gca, 'FontSize', 11);
%% FIGURE 2 - Initial mass variance
figure('Name', 'Initial Mass Variance', 'Position', [950 100 520 420]);
bar_h = bar(1:6, all_initial_mass, 'FaceColor', [0.6 0.6 0.6], 'EdgeColor', 'k');
xlabel('Sample number', 'FontSize', 12);
ylabel('Initial mass at t=0 (g)', 'FontSize', 12);
title('Uncovered Gelatin — Initial Sample Mass at t=0 (n=6)', 'FontSize', 12);
ylim([0 max(all_initial_mass) + 0.1]);
xticks(1:6);
grid on; box on;
```

```
set(gca, 'FontSize', 11);
```

2. **Sodium Alginate Degradation and Initial Mass Variance Plot**

```
%% Degradation Analysis - Sodium Alginate Crosslinked with CaCl2
clc; clear; close all;
%% DATA
time = [0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 60, 90];
% All 6 samples
all_initial_mass = [1.275, 1.67, 1.70, 1.316, 1.13, 1.25];
% Degradation analysis
raw_mass = [
  1.67,  1.70,  1.316, 1.13,  1.25;   % 0 min
  1.80,  1.80,  1.42,  1.23,  1.40;   % 5 min
  2.04,  1.53,  1.48,  1.17,  1.58;   % 10 min
  2.05,  2.12,  1.55,  1.01,  1.24;   % 15 min
  2.10,  1.99,  1.72,  0.97,  1.10;   % 20 min
  2.13,  1.97,  1.61,  0.91,  0.99;   % 25 min
  1.88,  1.80,  1.54,  0.78,  0.87;   % 30 min
  1.66,  1.73,  1.45,  0.67,  0.82;   % 35 min
  1.43,  1.58,  1.39,  0.59,  0.79;   % 40 min
  1.19,  1.40,  1.32,  0.51,  0.72;   % 45 min
  1.05,  1.30,  1.25,  0.45,  0.71;   % 60 min
  0.50,  0.45,  0.78,  0.32,  0.25;   % 90 min
];
%% STATISTICS
mean_mass = mean(raw_mass, 2);
sd_mass = std(raw_mass, 0, 2);
pct_individual = (raw_mass ./ raw_mass(1,:)) * 100;
pct_remaining = mean(pct_individual, 2);
pct_sd = std(pct_individual, 0, 2);
fprintf('Sodium Alginate - Results \n');
fprintf('Mean initial mass:          %.3f g\n', mean_mass(1));
fprintf('SD of initial mass:         %.3f g (%.1f%% of mean)\n', ...
  sd_mass(1), (sd_mass(1)/mean_mass(1))*100);
fprintf('%% mass remaining at 30 min: %.1f%%\n', pct_remaining(time==30));
fprintf('%% mass remaining at 45 min: %.1f%%\n', pct_remaining(time==45));
```

```
fprintf('%% mass remaining at 60 min: %.1f%%\n', pct_remaining(time==60));
fprintf('%% mass remaining at 90 min: %.1f%%\n\n', pct_remaining(time==90));
%% LINEAR FIT (dissolution phase 30-90 min)
decay_mask = time >= 30;
time_decay = time(decay_mask);
pct_decay = pct_remaining(decay_mask);
p = polyfit(time_decay, pct_decay, 1);
m = p(1);
b = p(2);
t_zero = -b / m;
fprintf(' Linear Fit (30-90 min) \n');
fprintf('Slope:                  %.3f %%/min\n', m);
fprintf('Extrapolated t = 0%%:       %.1f min\n\n', t_zero);
t_fit_range = linspace(30, t_zero, 300);
pct_fit = polyval(p, t_fit_range);
%% PEAK SWELLING
[peak_pct, peak_idx] = max(pct_remaining);
peak_time = time(peak_idx);
fprintf('Peak swelling:              %.1f%% at t = %d min\n\n', peak_pct, peak_time);
%% FIGURE 1 - Full degradation curve
figure('Name', 'Sodium Alginate Degradation', 'Position', [100 100 850 540]);
hold on;
y_max = max(pct_remaining + pct_sd) + 30;
patch([0, peak_time, peak_time, 0], [0, 0, y_max, y_max], ...
  [0.8 0.9 1.0], 'FaceAlpha', 0.2, 'EdgeColor', 'none', ...
  'DisplayName', 'Swelling phase');
patch([peak_time, 100, 100, peak_time], [0, 0, y_max, y_max], ...
  [1.0 0.85 0.85], 'FaceAlpha', 0.2, 'EdgeColor', 'none', ...
  'DisplayName', 'Dissolution phase');
x_band = [time, fliplr(time)];
y_band = [pct_remaining' + pct_sd', fliplr(pct_remaining' - pct_sd')];
fill(x_band, y_band, [0.85 0.85 0.85], 'FaceAlpha', 0.4, ...
  'EdgeColor', 'none', 'DisplayName', '\pm 1 SD band');
% Mean with error bars
errorbar(time, pct_remaining, pct_sd, 'ko-', ...
  'LineWidth', 2, 'MarkerSize', 7, 'MarkerFaceColor', 'k', ...
```

```
    'CapSize', 6, 'DisplayName', 'Mean \pm SD (n=5)');
% Linear fit
plot(t_fit_range, pct_fit, 'r--', 'LineWidth', 2, ...
    'DisplayName', ['Linear fit (est. dissolution: ' sprintf('%.0f', t_zero) ' min)']);
% Peak swelling marker
plot(peak_time, peak_pct, 'b^', 'MarkerSize', 10, 'MarkerFaceColor', 'b', ...
    'DisplayName', sprintf('Peak swelling (%d min)', peak_time));
% Initial mass reference
yline(100, 'k:', 'LineWidth', 1, 'DisplayName', 'Initial mass (100%)');
% Slope label directly on the red line
text(88, polyval(p, 88) + 6, ['Slope = ' sprintf('%.3f', m) ' %/min'], ...
    'FontSize', 9, 'FontName', 'Arial', 'Color', 'r', ...
    'HorizontalAlignment', 'left');
hold off;
xlabel('Time (min)', 'FontSize', 12);
ylabel('Mass remaining relative to t=0 (%)', 'FontSize', 12);
title('Sodium Alginate (CaCl_2 crosslinked) — Degradation in PBS (pH 7.4, 37°C)', ...
    'FontSize', 13);
legend('Location', 'southwest', 'FontSize', 9);
xlim([-2 100]);
ylim([0 y_max]);
grid on; box on;
set(gca, 'FontSize', 11);
%% FIGURE 2 - Initial mass variance
figure('Name', 'Initial Mass Variance', 'Position', [950 100 520 420]);
b = bar(1:6, all_initial_mass, 'FaceColor', [0.6 0.6 0.6], 'EdgeColor', 'k');
xlabel('Sample number', 'FontSize', 12);
ylabel('Initial mass at t=0 (g)', 'FontSize', 12);
title('Sodium Alginate — Initial Sample Mass at t=0 (n=6)', 'FontSize', 12);


ylim([0 max(all_initial_mass) + 0.3]);
grid on; box on;
set(gca, 'FontSize', 11);
xticks(1:6);
```

Conclusions/action items: This code was used to perform statistical analysis with the data collected during the sodium alginate and gelatin degradation testing. The code effectively made comprehensible plots that were used do display the results and analysis of each material. Further testing of degradation with more samples or different materials will implement this code to create plots, showing swelling and degradation.

04/29/2026 Experimentation Results

SIMON FETHERSTON - Apr 29, 2026, 9:34 PM CDT

Title: Experimentation Results

Date: 04/29/2026

Content by: Simon

Present: Simon

Goals: Present plots of testing results.

Content:

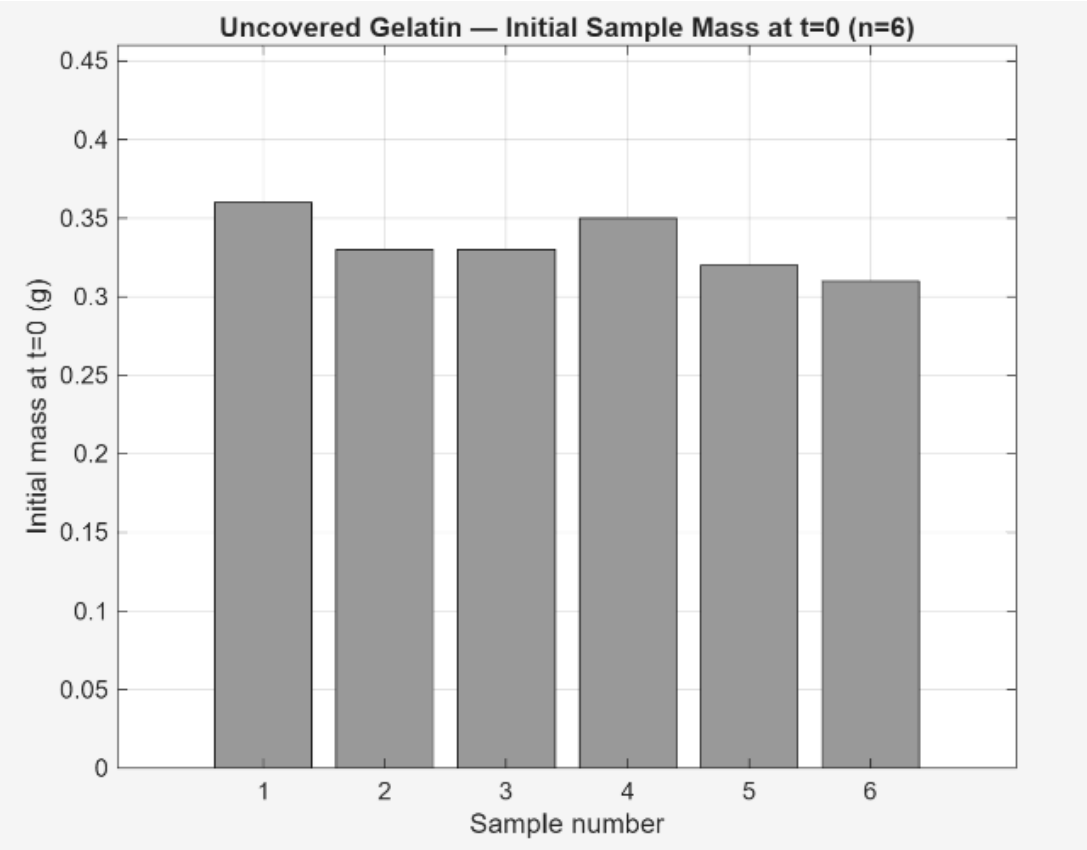


Figure 1: Uncovered gelatin initial sample masses

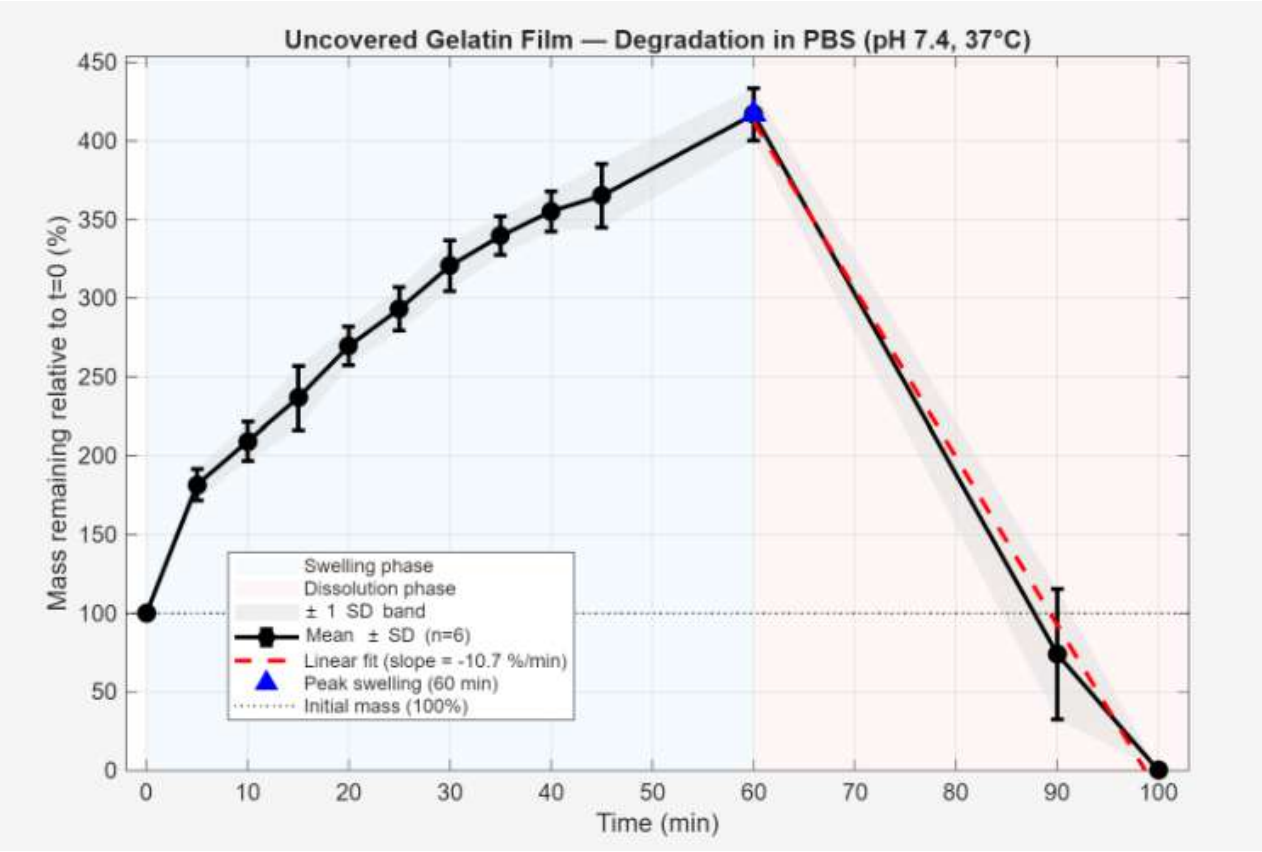


Figure 2: Degradation plot of uncovered gelatin films.

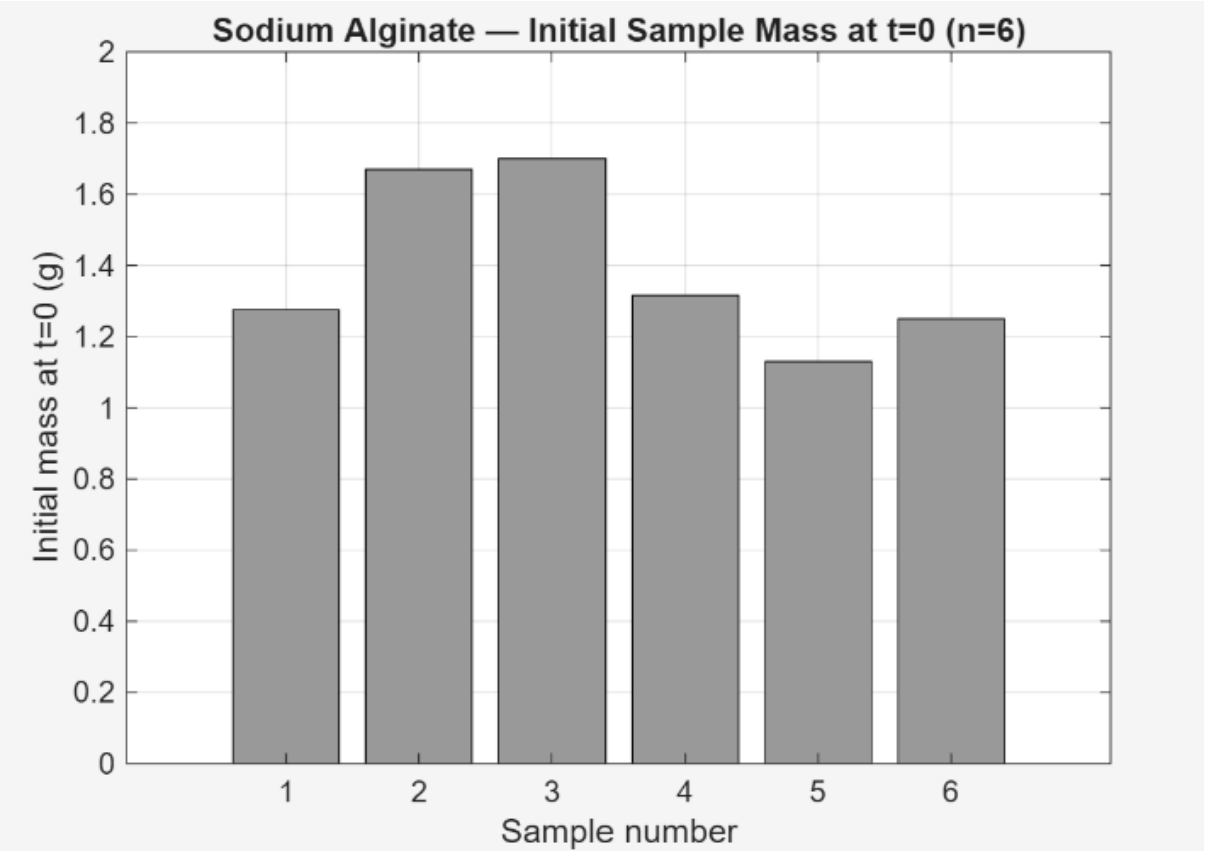


Figure 10: Sodium Alginate initial sample masses

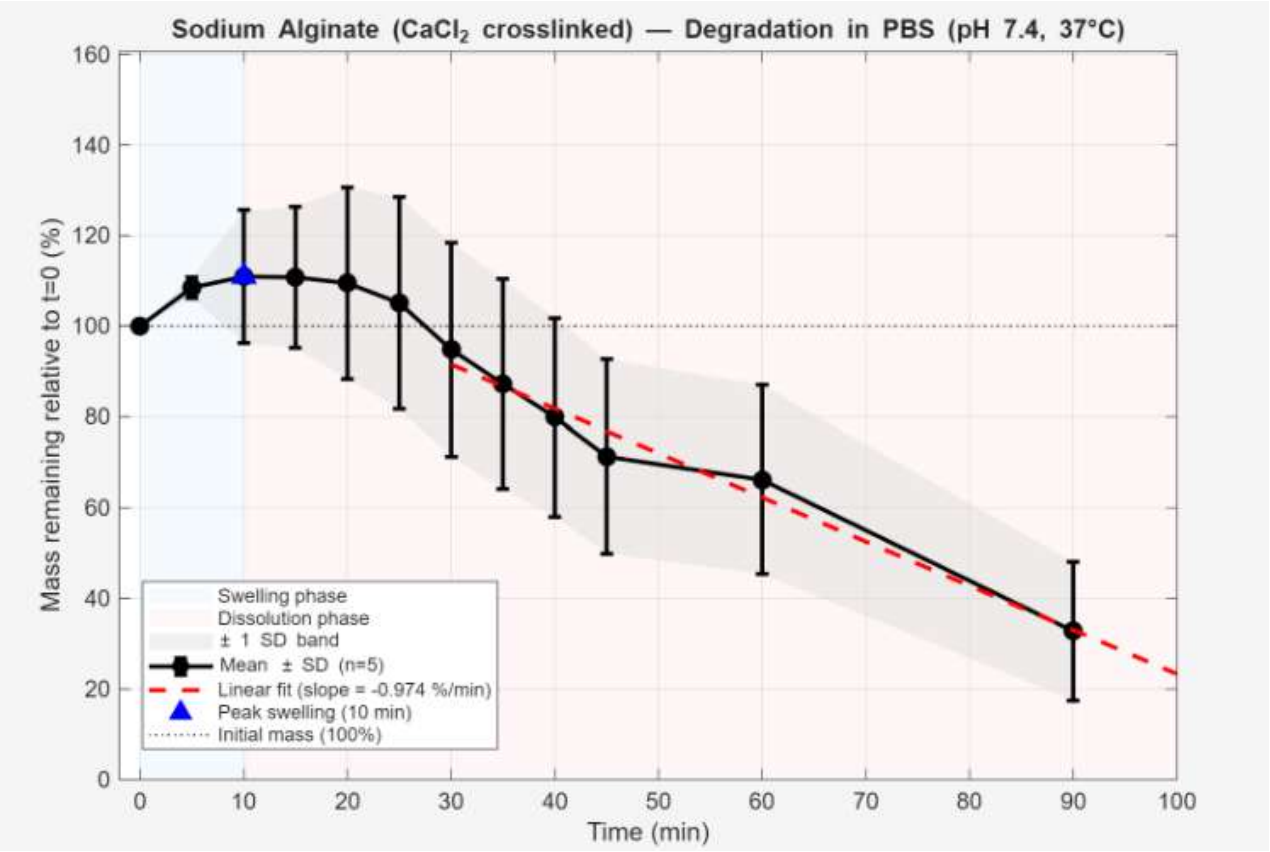


Figure 11: Degradation plot of Sodium Alginate. Estimated time to dissolution is 124 minutes.

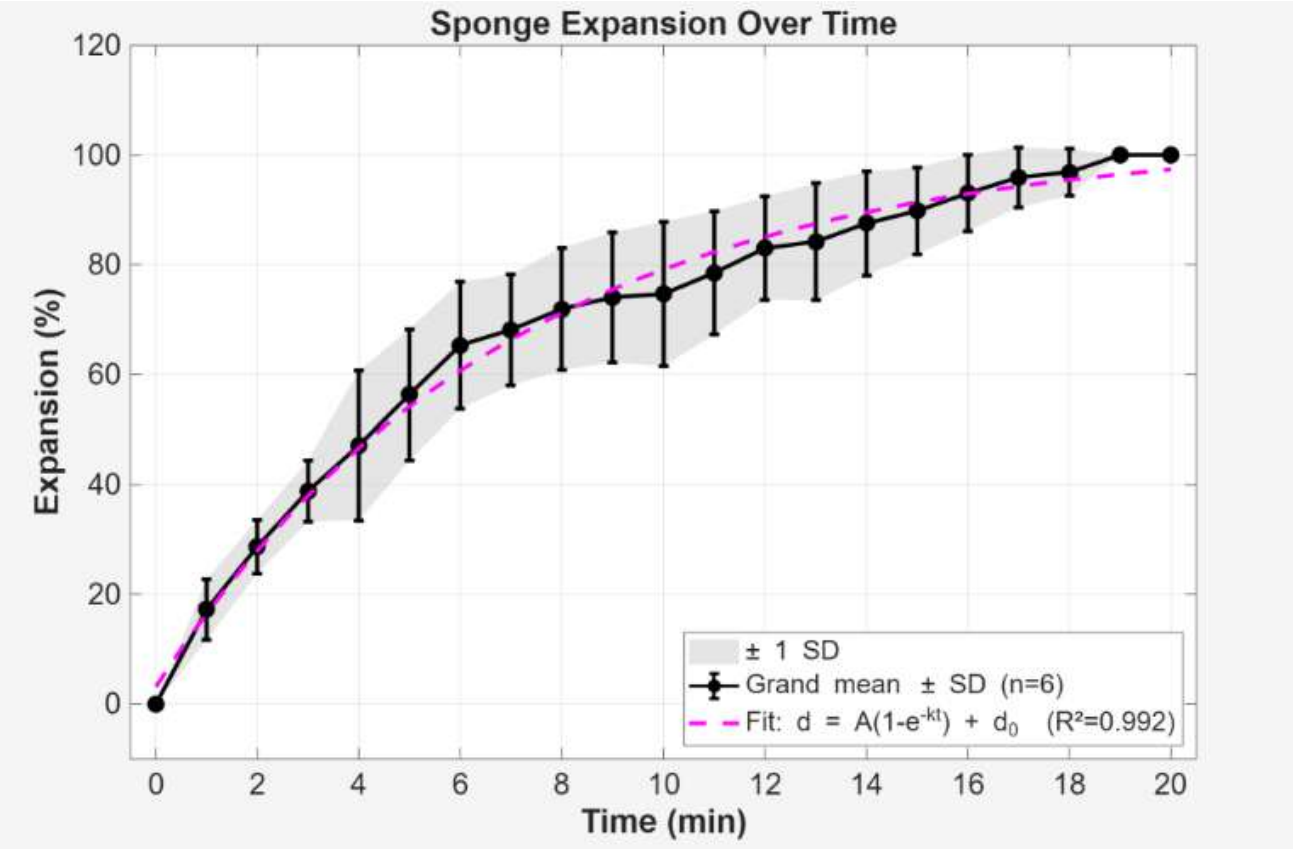


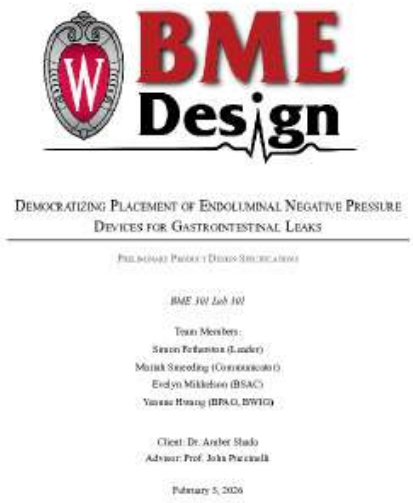
Figure 12: Mean gelatin coated sponge expansion in PBS

Conclusions/action items: These results show that sodium alginate had degradation properties closer to the desired criteria. The goal was to have degradation occur after 15 minutes. The uncovered gelatin had a large amount of swelling while the sodium alginate slightly swelled and then started to degrade after 10 minutes. Additionally, sponge expansion with the gelatin film revealed that a biodegradable film can have a released expansion

profile. While there was some rapid expansion of the sponge initially, the curve was logarithmic and did not allow full expansion until 18-20 minutes after being exposed to physiological conditions. Future development of the project will focus on developing a method of fabricating the sodium alginate around a sponge as it has more promising degradation characteristics.

02/05/2026 Product Design Specifications

SIMON FETHERSTON - Feb 05, 2026, 7:42 PM CST



DEMOCRATIZING PLACEMENT OF ENDOLUMINAL NEGATIVE PRESSURE DEVICES FOR GASTROINTESTINAL LEAKS

PRELIMINARY PRODUCT DESIGN SPECIFICATIONS

BME 101 Lab 101

Team Members:
Simon Fetherston (Leader)
Mariah Snowding (Communicator)
Evelyn Mikkelson (BSAC)
Yunxuan Hwang (BPAG, BWIG)

Client: Dr. Amber Stado
Advisor: Prof. John Puccinelli

February 5, 2026

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PDS_-_EndoVAC.pdf (302 kB)

02/23/2026 Preliminary Presentation

SIMON FETHERSTON - Feb 23, 2026, 4:07 PM CST

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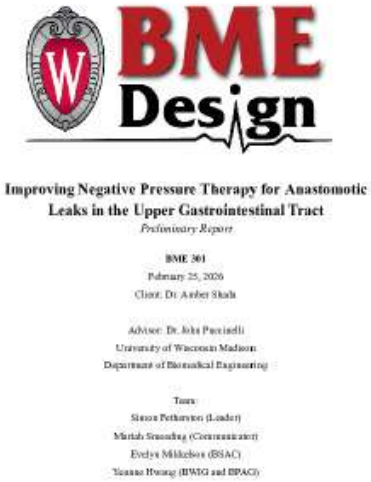
Preliminary_Presentation_1_.pdf (1.37 MB)

02/25/2026 Preliminary Report

SIMON FETHERSTON - Feb 27, 2026, 12:40 PM CST



Improving Negative Pressure Therapy for Anastomotic Leaks in the Upper Gastrointestinal Tract

Preliminary Report

BME 301

February 25, 2026

Client: Dr. Amber Shah

Advisor: Dr. John Puccinelli

University of Wisconsin Madison

Department of Biomedical Engineering

Team:

Simon Fetherston (Leader)

Mariah Smoothy (Communicator)

Evelyn Mikkelson (BSAC)

Yeanne Hwang (BWIG and BPAG)

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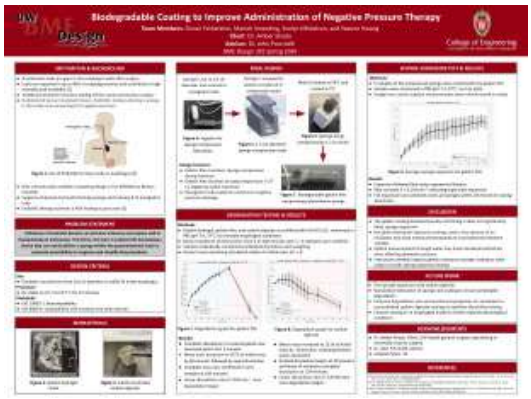
Preliminary_Report.pdf (1.13 MB)

04/28/2026 Final Poster

SIMON FETHERSTON - Apr 28, 2026, 5:48 PM CDT



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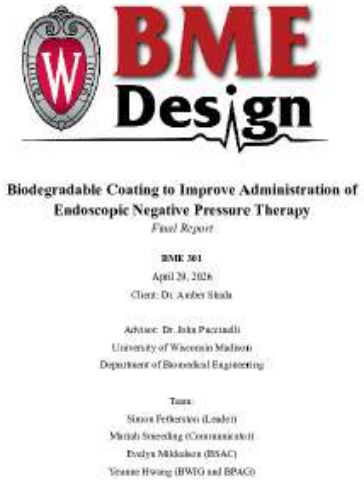
Final_Poster.pdf (2.79 MB)

04/29/2026 Final Report

SIMON FETHERSTON - Apr 29, 2026, 9:12 PM CDT



Biodegradable Coating to Improve Administration of Endoscopic Negative Pressure Therapy

Final Report

BME 301

April 29, 2026

Client: Dr. Amber Shida

Advisor: Dr. John Puccinelli

University of Wisconsin Madison

Department of Biomedical Engineering

Team:

Simon Fetherston (Leader)

Mariah Smeeding (Communicator)

Evelyn Mikkelson (BSAC)

Yeonne Hwang (BWIG and BPAG)

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EndoVAC_Final_Report.pdf (3.97 MB)

02/16/26 - Anastomotic leaks

MARIAH SMEEDING - Feb 16, 2026, 10:04 PM CST

Title: Anastomotic Leak Current Treatments

Date: 02/16/2026

Content by: Mariah Smeeding

Present: n/a

Goals: To understand why anastomotic leaks, happen and what is currently done to treat them.

Content:

Anastomotic leaks are a life-threatening complication following GI reconstruction surgery. Anastomosis is a surgery that connects two ends of a channel (a tube or passageway) together. It's usually done after part of the channel has been removed (resected) [1]. Anastomotic leaks occur in up to 40% of esophagectomies and up to 17% of gastrostomies — and when they do, leakage-related mortality can reach 35% or higher [2].

Treatments

- Immediately antibiotics
- Management depends on factors such as location of anastomosis, time point of diagnosis of leakage, extent of anastomotic disruption, perfusion/ischemia/necrosis of conduit, involvement of surrounding organs, whether or not the leakage is contained, clinical symptoms (e.g. sepsis), success of initiated management, and others [2].
- The site if first assessed via endoscope to see extend of damage. If damage is past the point of healing and tissue is completely deteriorated, the debridement will be surgically removed.
- VAC therapy comes in now. This process will be repeated a few times and if it seems the tissue is healing, the process will continue.
- In the case VAC therapy does not work, the site must be fully replaced.

Citations:

[1] "Anastomotic Leak: Symptoms, Treatment & What It Is," Cleveland Clinic. Accessed: Feb. 16, 2026. [Online]. Available: https://my.clevelandclinic.org/health/diseases/22324-anastomotic-leak

[2] R. Hummel and D. Bausch, "Anastomotic Leakage after Upper Gastrointestinal Surgery: Surgical Treatment," *Visc Med*, vol. 33, no. 3, pp. 207–211, Jun. 2017, doi: 10.1159/000470884.

Conclusions/action items:

Making VAC therapy easier to perform may increase the chances of it working so majorly invasive reconstruction surgery can be avoided.

Add info to the presentation background information slide.

01/29/26 - Smart Polyurethane Endosponges for Endoluminal Vacuum Therapy

MARIAH SMEEDING - Jan 29, 2026, 12:31 PM CST

Title: Smart Polyurethane Endosponges for Endoluminal Vacuum Therapy - Library Article 1/4

Date: 01/29/26

Content by: Mariah Smeeding

Present: n/a

Goals: Explore different methods for endoluminal vacuum therapy and how it could be made better by the integration of a bacterial sensor.

Content:

Clinical need for endoluminal vacuum therapy:

- Anastomotic leakages (surgical connection failures) after esophageal surgery occur in up to 30% of cases
- These leaks can be fatal if untreated, causing severe infections and organ failure
- Current sponges are left in place 4-6 days, but there's no way to monitor bacterial growth in real-time
- Patients with diabetes, obesity, heart issues, etc. are at higher risk

In this study, researchers converted commercial polyurethane (PU) sponges used in endoluminal vacuum therapy into "smart" biomedical devices by adding an electrochemical sensor that can detect bacterial growth.
Similar to the Endo-SPONGE, these sponges are used to treat anastomotic leakages by applying negative pressure to promote tissue healing and drain infections. Adding bacteria-sensing capability helps monitor the healing process and prevent infection development.

The way the electrochemical sensor works is by detecting NADH (a molecule produced during bacterial respiration otherwise known as a bacterial metabolite) that leaks from bacteria into the surrounding environment [1]. This is specific to bacteria because normal human cells keep NADH contained within their mitochondria, so it doesn't leak out. It converts chemical reactions into measurable electrical signals (current, voltage, or impedance) proportional to the concentration of target substances.
Since endoluminal vacuum therapy sponges have extremely complex 3D geometry, it was found that making sensor integration is much harder than flat implants like titanium prostheses or even woven surgical meshes.

The researchers in this study discovered that by coating PU sponges with PEDOT (a conductive polymer) creates a "smart" sensor that can detect bacteria growth in real-time, allowing doctors to intervene before serious infections develop.

Citations:

[1] A. Fontana-Escartín, S. Lanzalaco, E. Armelin, P. Turon, J. Ardèvol, and C. Alemán, "Smart polyurethane endosponges for endoluminal vacuum therapy: Integration of a bacteria sensor," Colloids and Surfaces A: Physicochemical and Engineering Aspects, vol. 692, p. 133947, Jul. 2024, doi: 10.1016/j.colsurfa.2024.133947. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0927775724007112

Conclusions/action items:

Adding a biosensor to our design may be a very beneficial addition as it would lower the risk of serious infection by allowing doctors to treat infection right away.

01/29/26 - Endoluminal Vacuum Therapy Using a New “Fistula Sponge”

MARIAH SMEEDING - Jan 29, 2026, 12:53 PM CST

Title: Endoluminal Vacuum Therapy Using a New “Fistula Sponge” - Library Article 2/4

Date: 01/29/26

Content by: Mariah Smeeding

Present: n/a

Goals: Compare different materials and sizes for treatment of endoluminal cavities using VAC

Content:

Clinical Issue: Anastomotic leaks and perforations in the upper GI tract (esophagus, stomach) have 5-50% mortality rates due to severe infections like sepsis and mediastinitis [1].

This study covers Fistula Sponges. The fistula sponge fills small leaks that are too small for the Eso-SPONGE but still need active drainage and negative pressure therapy. Both systems work on the same principle (negative pressure promotes healing, drains infection) but are optimized for different defect sizes [1]. The fistula sponge is made from porous drainage foam (Suprasorb CNP) sutured to a nasogastric tube.

Feature	Eso-SPONGE	Fistula Sponge
Size	Larger and bulkier	Smaller, more flexible
Defect Treated	>10mm	<10mm
Placement	Can be difficult in small spaces	Easier in tight anatomical Spaces
Commercial availabity	Licensed product	Custom-made per patient by doctors
Treatment time	Longer (about 15 days)	Shorter (about 8 days)

Table 1: A Comparison between the Eso-SPONGE and Fistula Sponge

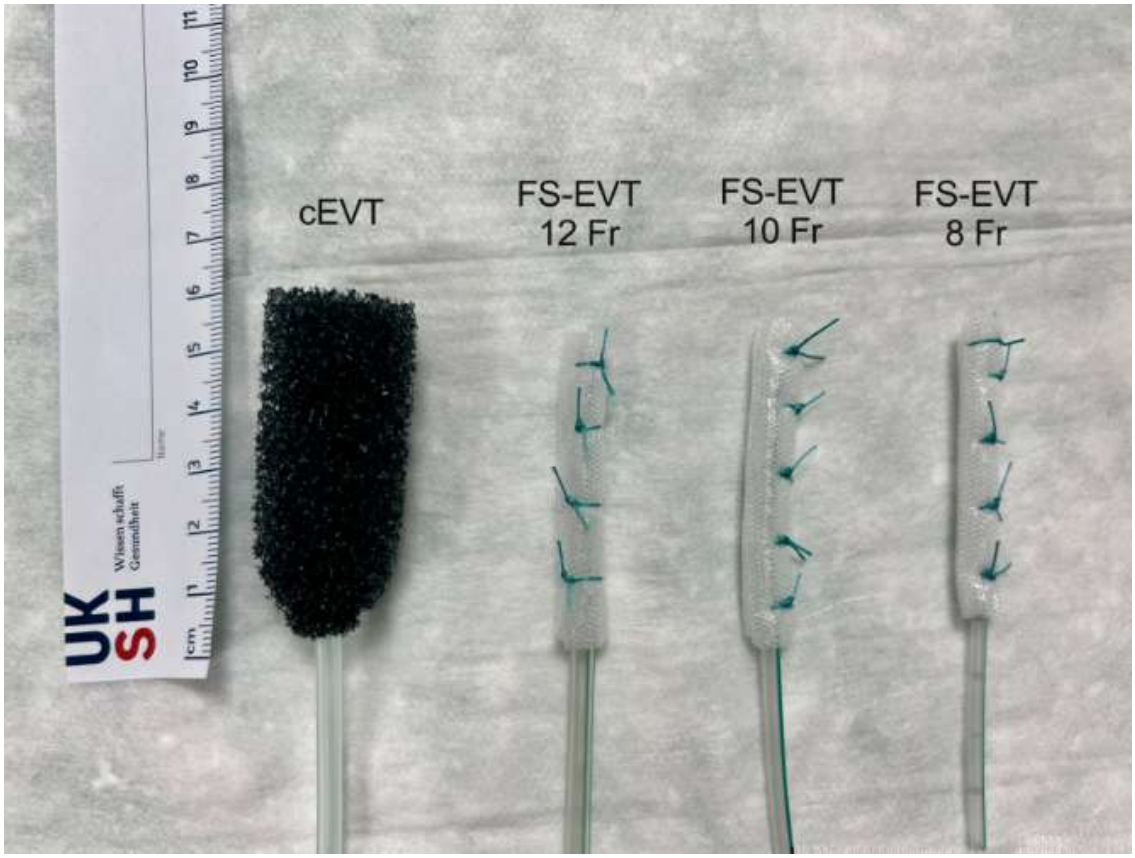


Figure 1. Comparison of the systems for endoluminal vacuum therapy; cEVT (Eso-SPONGE®) and 3 wrapping confirgurations of FS-EVT (fistulas sponge) [1].

Citations:

[1] F. Richter *et al.*, “Endoluminal Vacuum Therapy Using a New ‘Fistula Sponge’ in Treating Defects of the Upper Gastrointestinal Tract—A Comparative, Retrospective Cohort Study,” *Medicina*, vol. 60, no. 7, p. 1105, Jul. 2024, doi: 10.3390/medicina60071105.

Conclusions/action items:

A good question for the client would be what is the size range of cavities we should be designing our device to treat? Although the sponges are made from the same material (PU), they have different appearances. The Eso-SPONGE is manufactured with large, interconnected air pockets throughout and is designed to be bulky and maintain its shape to fill large cavities. The fistula sponge is manufactured as compressed, thin layers making it much thinner and more flexible.

01/29/26 - Differences in Fluid Removal of Different Open-Pore Elements for Endoscopic Negative Pressure Therapy

MARIAH SMEEDING - Jan 29, 2026, 1:24 PM CST

Title: Differences in Fluid Removal of Different Open-Pore Elements for Endoscopic Negative Pressure Therapy - Library Article 3/4

Date: 01/29/26

Content by: Mariah Smeeding

Present: n/a

Goals: Research how different sponge types result in different drainage.

Content:

This study compares the fluid drainage efficiency of different open-pore suction devices (OPSDs) used in endoscopic negative pressure therapy for upper GI tract defects.
The devices tested:

- 6 hand-made/prototype devices (using PU sponge or CNP film wrapped around different tubes)
    - OPSD with drainage film on gastric tube
        - no feeding option
    - OPSD with PU-sponge on gastric tube
        - no feeding option
    - OPSD with drainage film on gastric tube of a two-lumen tube
        - allows feeding through intestinal tube
    - OPSD with drainage film on gastric part of a treluminal feeding tube
        - allows feeding through intestinal tube
    - OPSD with drainage film on duodenal tube with inserted jejunal tube
        - can reach duodenal leakages
    - OPSD with PU-sponge and drainage film on gastric tube with inserted jejunal tube
        - Complex design combining both materials, allows feeding, variable tube length
- 2 commercial devices (Eso-Sponge and VAC-Stent)

Three specifications were tested:

1. Time to achieve target negative pressure (125 mmHg)
   Importance: the target pressure is essential for stimulating tissue regeneration. It enhances local blood perfusion, reduces tissue edema, promotes granulation tissue formation, and facilitates wound edge approximation.

2. Time to remove 100 ml of water
   Importance: Rapid and continuous fluid removal is crucial for preventing bacterial colonization and infection. The GI tract produces significant secretions (saliva, gastric acid, bile) that accumulate in defect sites. Devices with poor drainage efficiency allow fluid stagnation, creating an ideal environment for biofilm formation and sepsis, which is the primary cause of mortality in these patients.

3. Material Resistance (calculated as Δ pressure / flow rate) - lower resistance = easier fluid flow = better drainage performance
   Importance: Material resistance directly impacts clinical performance.

Performance Summary:

Achieving Target Vacuum Pressure (125 mmHg):

- Self-made drainage film on gastric tube failed to reach target pressure in all tests while all other devices successfully reached target pressure.
- Fastest to reach target: Self-made PU-sponge + drainage film on gastric tube with jejunal tube at 13.2 seconds while commercial devices performed similarly: Eso-SPONGE at 27.2 seconds and VAC-Stent at 28.3 seconds

Time to Remove 100 ml of Water:

- Fastest drainage: Self-made drainage film on gastric tube (26.1 sec), Self-made drainage film on treluminal feeding tube (26.4 sec), and Self-made PU-sponge on gastric tube (29.4 sec)
- Slowest drainage: Self-made PU-sponge + drainage film on gastric tube with jejunal tube at 327.5 seconds - over 10 times slower than the fastest
- Eso-SPONGE at 57.4 seconds and VAC-Stent at 53.5 seconds

Material Resistance:

- Self-made drainage film on gastric tube had no calculable resistance because it could not meet target pressure
- Lowest resistance (best flow): Self-made PU-sponge on gastric tube (29.5) and Self-made drainage film on treluminal feeding tube (33.0)
- Highest resistance: Self-made PU-sponge + drainage film on gastric tube with jejunal tube at 409.3
- Eso-SPONGE (71.6) and VAC-Stent (66.8)

The study showed that achieving target vacuum pressure doesn't guarantee efficient drainage. The self-made PU-sponge + drainage film device with jejunal tube reached target pressure quickly (13.2 sec) but had the slowest fluid removal (327.5 sec) due to extremely high material resistance (409.3). This demonstrates that both vacuum achievement AND low material resistance are necessary for optimal fluid drainage.
Simpler designs with single-material construction (either drainage film or PU-sponge alone) performed best for fluid removal. Adding complexity (combining materials, multiple lumens for feeding) dramatically increased resistance and reduced drainage efficiency.

Conclusions/action items:
From the study, the treluminal feeding tube with drainage film seemed to offer the best balance of reaching target pressure and allowing sufficient drainage. Although, commercial devices reach therapeutic vacuum pressure faster and offer convenience (ready-to-use, no assembly required, consistent quality), the treluminal design allowed for very efficient fluid drainage which would make it ideal for high-secretion environments where rapid fluid evacuation is critical to prevent infection.

MARIAH SMEEDING - Feb 04, 2026, 7:08 PM CST

Source:

[1] K. T. Jansen *et al.*, “Differences in fluid removal of different open-pore elements for endoscopic negative pressure therapy in the upper gastrointestinal tract,” *Sci Rep*, vol. 12, p. 13889, Aug. 2022, doi: 10.1038/s41598-022-17700-3.

02/06/26 - Theranostic Nano-Enabled Polyurethane Eso-Sponges

MARIAH SMEEDING - Feb 07, 2026, 10:03 AM CST

Title: Theranostic nano-enabled polyurethane eso-sponges coupled to surface enhanced Raman scattering for detection and control of bacteria killing

Date: 02/06/26

Content by: Mariah Smeeding

Present: n/a

Goals: Research materials that may be applicable to endoluminal therapy and how gold or silver nano-particle integration may be pivotal.

Content:

Microbial resistance: ability of microorganisms, particularly bacteria, to withstand the effects of antimicrobial agents, resulting in treatment failures and complicating the effective chemotherapy of infectious diseases.

This study developed a theranostic polyurethane sponge for endoVAC therapy that can simultaneously detect and eliminate bacterial infections. They created a polyurethane based sponge integrated with:

- Gold-chitosan core-shell nanoparticles and silver-phenolated lignin core-shell nanoparticles
    - metal nanoparticles enable Surface-Enhanced Raman Scattering (SERS). Allows rapid identification of both Gram-positive and Gram-negative bacteria through optical fiber imaging without invasive procedures. [1]
        - When laser light hits the metal nanoparticles, they absorb that light energy and convert it into heat. This localized heating kills nearby bacteria without harming the surrounding healthy tissue. Good for localized treatment. This happens because gold and silver nanoparticles are very good at absorbing specific wavelengths of light due to a phenomenon called surface plasmon resonance (SPR) where the light causes electrons on the metal surface to oscillate. [1]
        - Bacteria tend to colonize and form biofilms on medical device surfaces meaning the bacteria is in direct contact with or very close to the nanoparticle-coated surface.
- A thermosensitive hydrogel coating
    - responds to temperature changes, helping distinguish between healthy tissue (37°C) and infected states (40°C). [1]
- Raman reporter molecules -
    - They serve as a detection signal. In this study, 4-mercaptobenzonitrile (4-MB) was used, which has a very distinctive chemical signature, particularly a nitrile group (C≡N) that shows up at 2230 cm^{-1} in Raman spectroscopy. [1]
    - This particle usually shows up in what they called a 'quiet' region, where the polyurethane sponge material doesn't have any interfering peaks. This makes it easy to spot without background noise.
    - The Signal Amplification (SERS Effect) happens when these particles are present with gold and silver nanoparticles and essentially amplify their signal. This makes it so doctors could easily see that the nanoparticles are present and properly attached to the sponge and working as they should be. [1]
- Uses an optical fiber threaded through the endoscope or endotracheal tube. Light waves can be sent through the optical fiber to the target location with laser.

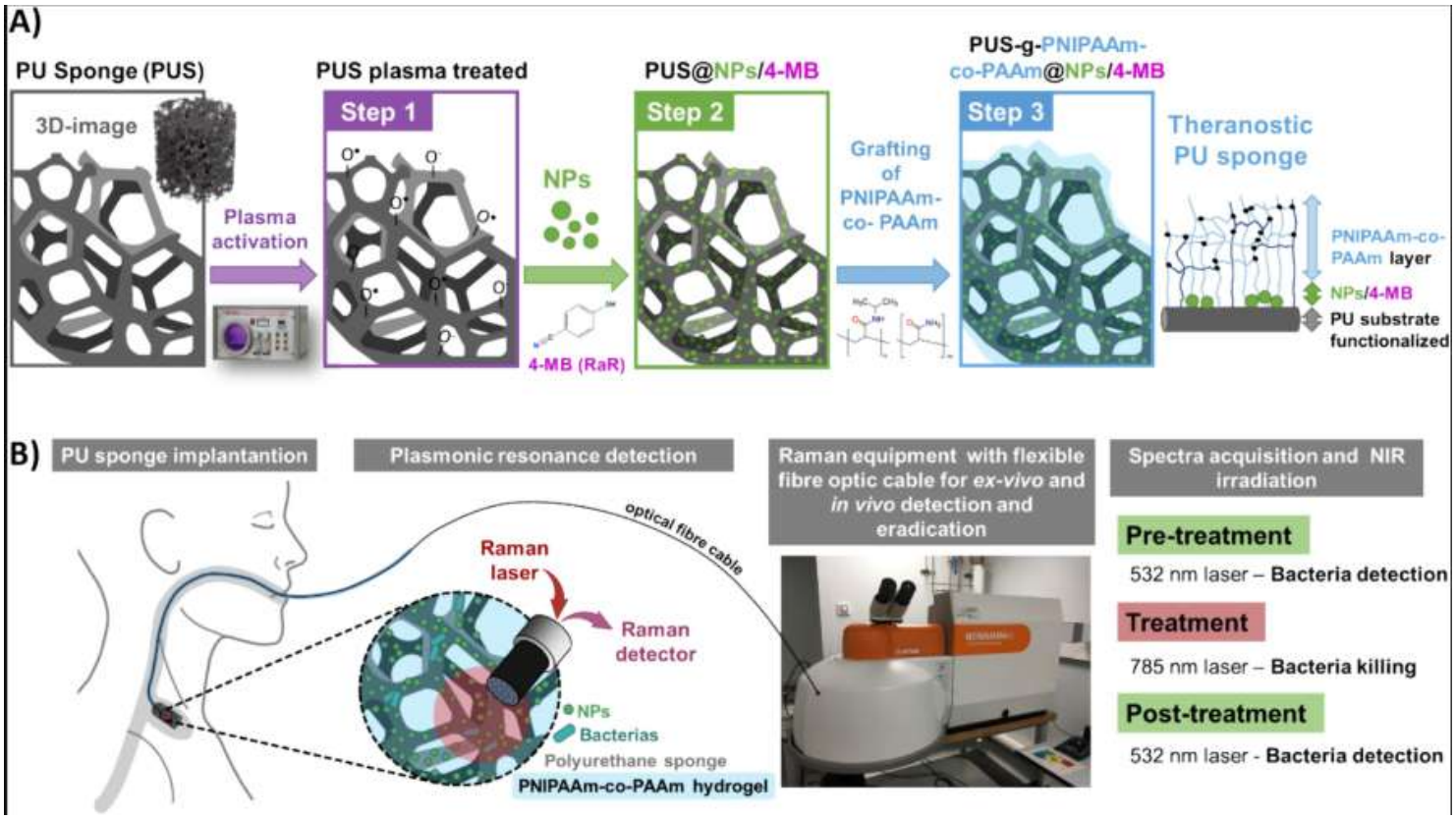


Figure 1. A) Schematic illustration for the procedure employed to carry out the functionalization of PUS (Step 1 – activation of PU surface with cold-plasma; Step 2 – deposition and covalent bonding of metal-biopolymer NPs together with Raman reporter molecules (4-MB), Step 3 – graft copolymerization of NIPAAm and AAm, crosslinked with MBA, for hydrogel infiltration within the PUS 3D-structure, as represented in Step 4.) B) Hypothetical representation of the novel theranostic PU device implanted and mode of operation of an optical cable, placed in an endotracheal tube, to carry out the bacteria detection and bacteria clearance, thanks to the presence of the SERS NPs. [1]

Citation:

[1] J. Mingot, S. Lanzalaco, G. Ferreres, T. Tzanov, C. Alemán, and E. Armelin, “Theranostic nano-enabled polyurethane eso-sponges coupled to surface enhanced Raman scattering for detection and control of bacteria killing,” *Chemical Engineering Journal*, vol. 497, p. 154617, Oct. 2024, doi: 10.1016/j.cej.2024.154617.

Conclusions/action items:

This technology could enable early detection of bacterial infections (before the critical 72-hour window) in patients with surgical anastomotic leaks, potentially preventing tissue integration complications and reducing the need for additional post-surgery interventions.

02/26/26 - Protease-Degradable PEG

MARIAH SMEEDING - Mar 06, 2026, 1:28 PM CST

Title: Protease-Degradable PEG

Date: 02/26/26

Content by: Mariah Smeeding

Present: n/a

Goals: Research existing degradable biomaterials

Content:

This study biofunctionalized a polymer hydrogel to promote tissue growth and prevent infection. They made a protease-degradable PEG hydrogel functionalized with the RGD integrin-binding motif to enhance cell adhesion and the antimicrobial peptide hLf1–11 (LF) to provide antibacterial activity.

Although the binding motif would not be relevant for our project as we do not want the tissue to adhere to the coating, the protease-degradable PEG hydrogel could be worth exploring. There are many proteases in a wound environment that could drive degradation such as MMPs and neutrophil elastase. The addition of a antimicrobial peptide would also be beneficial in endoVAC therapy.

Making it protease-degradable: They used a Michael-type addition reaction between PEG-4Mal (maleimide-functionalized) and thiol-containing crosslinkers. The VPM peptide was added as a crosslinker to tune degradation. VPM is a protease-sensitive peptide sequence, so when proteases (like MMPs) are present in the cellular environment, they cleave that crosslink and the hydrogel breaks down.

Adding antimicrobial properties: They incorporated the antimicrobial peptide hLf1-11 (LF) by conjugating it directly to the PEG-4Mal backbone via a thiolated RGD-LF peptide before crosslinking. They essentially added the RGD binding motif and the antimicrobial peptide together which tethers the antimicrobial peptide into the hydrogel structure.

When hydrogel degrades enzymatically it releases fragments still containing the LF antimicrobial peptide, which could provide a sustained antibacterial effect over time.

Limitations: This is a bulk hydrogel, not a film. I am not sure how we could get the PEG hydrogel to be thin enough and strong enough to cover a compressed sponge.

Citations:

[1] P. López-Gómez, N. Mehwish, M.-P. Ginebra, and C. Mas-Moruno, “Bioactive and degradable PEG hydrogels: A multifunctional approach for tissue regeneration and antibacterial protection,” *Biomaterials Advances*, vol. 180, p. 214553, Mar. 2026, doi: 10.1016/j.bioadv.2025.214553.

Conclusions/action items:

Research how this could be achieved and if this is something that we could do.

03/03/2026 - Biodegradable PVA/PLGA Material

MARIAH SMEEDING - Mar 06, 2026, 1:28 PM CST

Title: PVA + PLGA

Date: 03/03/2026

Content by: Mariah S

Present: n/a

Goals: To research material options for the degradable film that would provide enough mechanical strength to compress the PU sponge but also be able to degrade in the body at a reasonable rate.

Content:

The force needed to keep a PU sponge compressed scales significantly with how dense and stiff the foam is. Medical-grade PU sponges used for implant delivery are typically soft/flexible, which is good however there is still significant spring back force to be taken into account [1]. Low density PU foams have a young's modulus of 0.08–0.93 MPa and yield strengths of just 0.01–0.07 MPa so they are pretty soft [1].

PVA + PLGA blend:

- PLGA films achieve tensile strength up to ~58 MPa, exceeding most PLA and PLGA variants due to the glycolide component [2].
- PGLA is also stiff, the average Young's modulus of PLGA nanofibers are around 244 MPa [2]. So it actively resists deformation rather than slowly creeping.
- Adding PVA improves ductility, so the film can wrap around a curved sponge without cracking [2].
- Higher PVA content accelerates degradation and water uptake, which could cause the wrapper to soften and release the sponge prematurely.

One study on dental scaffolds examines PVA and PLGA together in a degradable scaffold:

- PVA was used as a binder in 3D-printed PLGA scaffolds for dental socket preservation
- They addressed PVA present in the scaffold may have a lower degradation rate, resulting in undue delay in degradation. PVA slows PLGA degradation [3].

Ideas to wrap the sponge:

- Create a PVA/PLGA film that is flat
- Wrap the flat film around the compressed sponge and then heat seal it
- Freeze sponge to compress? Potentially with dry ice or liquid nitrogen

Citations:

[1] M. Abdullah, S. Ramtani, and N. Yagoubi, “Mechanical properties of polyurethane foam for potential application in the prevention and treatment of pressure ulcers,” *Results in Engineering*, vol. 19, p. 101237, Sep. 2023, doi: 10.1016/j.rineng.2023.101237.

[2] J. Jeong, S. Yoon, X. Yang, and Y. J. Kim, “Super-Tough and Biodegradable Poly(lactide-co-glycolide) (PLGA) Transparent Thin Films Toughened by Star-Shaped PCL-b-PDLA Plasticizers,” *Polymers (Basel)*, vol. 15, no. 12, p. 2617, Jun. 2023, doi: 10.3390/polym15122617.

[3] R. N. V. C. Virinthorn, M. Chandrasekaran, K. Wang, and K. L. Goh, “Post-process optimization of 3D printed poly(lactic-co-glycolic acid) dental implant scaffold for enhanced structure and mechanical properties: effects of sonication duration and power,” *J Mater Sci Mater Med*, vol. 32, no. 8, p. 91, 2021, doi: 10.1007/s10856-021-06561-3.

Conclusions/action items:
The issue is that all polymer films will creep. They'll slowly deform over time under the constant outward pressure of a compressed sponge. So, maybe we could create a wrapper that would keep it compressed and sealed off from moisture up until the procedure is happening.

Meet with team before client meeting to discuss these new findings

Meet with client to discuss ordering materials

01/28/26 - Eso/Endo-Sponge

MARIAH SMEEDING - Jan

Title: Eso-SPONGE and Endo-sponge

Date: 01/28/26

Content by: Mariah Smeeding

Present: n/a

Goals: Research other VAC designs made for anastomotic treatments.

Content:

The Eso-SPONGE, designed by Boston Scientific, is designed for the prevention and treatment of anastomotic leakages, and for the treatment of perforations, in the upper gastrointestinal tract. SPONGE is made for treatment of anastomotic leakages and perforations in the lower gastrointestinal track. They both involve the employment of an endoscope and measuring tool to visualize Then the sponge is inserted via a tube and a pusher. There may be as many as 3 sponges in one cavity depending on size. Once the sponges are placed, the lower pressure vacuum system th and begin the suction process. This removes GI leakages out of the body, preventing infection and, in worse cases, sepsis. The suction process creates a constant seal between the sponge anc promoting the granulation, the healing process is reduced significantly and promotes the shrinkage of the cavity. As the cavity shrinks, so do the sponge sizes, which are to be changed every 48

The Endo-SPONGE is a closer aligns with our project goals to treat endoluminal cavities with endoscope. Below is a figure of the Endo-SPONGE:

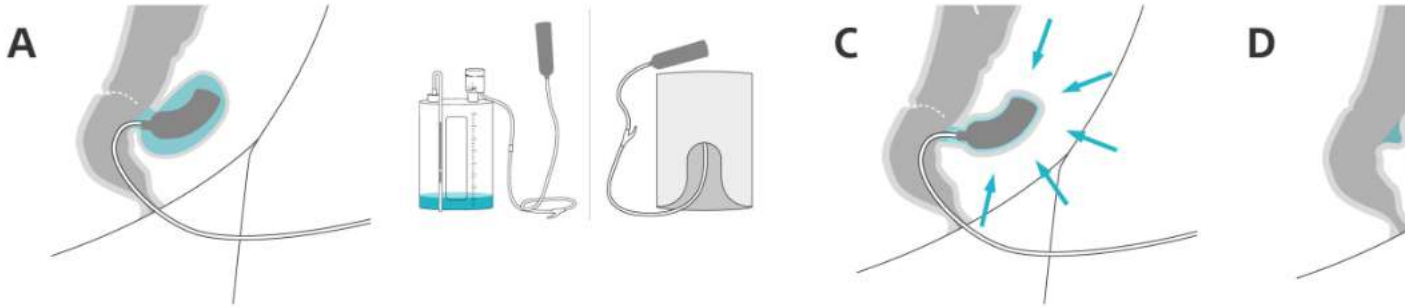


Figure 1. A: Endoscopic insertion of the sponge into the leakage cavity B: The drainage tube is routed out through the anus and connected to a vacuum system.C:The application c continuous drainage of the fluid and the sponge in the cavity promotes the cleaning of the surface. D: Endo-SPONGE therapy progressively reduces cavity size, leading to eventua [2]

Citations:

[1] Boston Scientific, "Eso-SPONGE Endoluminal Vacuum Therapy," Marlborough, MA, USA. [Online]. Available: https://www.bostonscientific.com/en-EU/products/endoluminal-vacuum-therapy/ Accessed: Jan. 29, 2026.

[2] Boston Scientific, "Endo-SPONGE Endoluminal Vacuum Therapy," Marlborough, MA, USA. [Online]. Available: https://www.bostonscientific.com/en-EU/products/endoluminal-vacuum-therapy Accessed: Jan. 29, 2026.

Conclusions/action items:

With this design in mind, how could it be made easier for doctors to use? What are complications that could arise due to this design?

01/30/26 - Endoscopic negative pressure therapy for duodenal leaks

MARIAH SMEEDING - Jan 30, 2026, 11:23 AM CST

Title: Endoscopic negative pressure therapy for duodenal leaks - Library Article 4/4

Date: 01/30/26

Content by: Mariah Smeeding

Present: n/a

Goals: Research to get a better understanding of how lower GI tract perforations are treated with VAC therapy.

Content:

This study is a 4-year retrospect case following the ENPT (also called endovac or vacuum-assisted closure) treatments of 10 patients: 6 with primary duodenal leaks and 4 with duodenal stump insufficiencies following surgery.
The therapy uses an open-pore suction device (OPSD), either open-pore foam drainage (OPD) or open-pore film drainage (OFD), wrapped around a perforated probe. The device is placed at the leak site endoscopically and connected to continuous vacuum (−125 mmHg) [1]. All devices were handmade prototypes customized to each case. No commercial sponges.

Clinical details:

- ENPT served as first-line sole therapy in 7 of 10 patients
- Mean treatment duration: 11 days
- Mean hospital stay: 30 days
- Only 2 patients required re-operation after starting ENPT
- No patients needed surgery after ENPT completion

It was found that the most challenging part was determining appropriate probe length to safely reach the duodenal leak while keeping the open-pore element in place despite intestinal motility.

Citations:

[1] D. Wichmann *et al.*, “Endoscopic negative pressure therapy for duodenal leaks,” *Front. Surg.*, vol. 10, Apr. 2023, doi: 10.3389/fsurg.2023.1099457.

Conclusions/action items:

ENPT shows high success rates for duodenal leaks across multiple etiologies (perforations after EMR, sutured ulcers, diverticular perforations, post-surgical stump insufficiencies), though duodenal applications remain less well-documented than esophageal or rectal ENPT [1]. Our team should consider how our device will be administered and how will we measure how large the cavity is.

02/07/26 - Endoluminal Wound Vacuum and Stent Therapy for Large Esophageal Leaks

MARIAH SMEEDING - Feb 07, 2026, 10:56 AM CST

Title: Endoluminal Wound Vacuum and Stent Therapy for Large Esophageal Leaks

Date: 02/07/26

Content by: Mariah Smeeding

Present: n/a

Goals: How do stents help endoVAC therapy, what is their purpose?

Content:

This study discusses the outcomes of 3 patients who received minimally invasive simultaneous endoluminal wound vacuum therapy and an esophageal stent (sEV+S) treatment for uncontained esophageal leaks into the pleural space after esophagectomy. In this technique, a black sponge sutured to the end of a drain is placed endoscopically into the leak cavity. An esophageal stent is then centered around the leak site.

Esophageal leaks can be particularly difficult to repair because the esophagus lacks serosa and a robust blood supply, making it prone to insufficient wound healing.

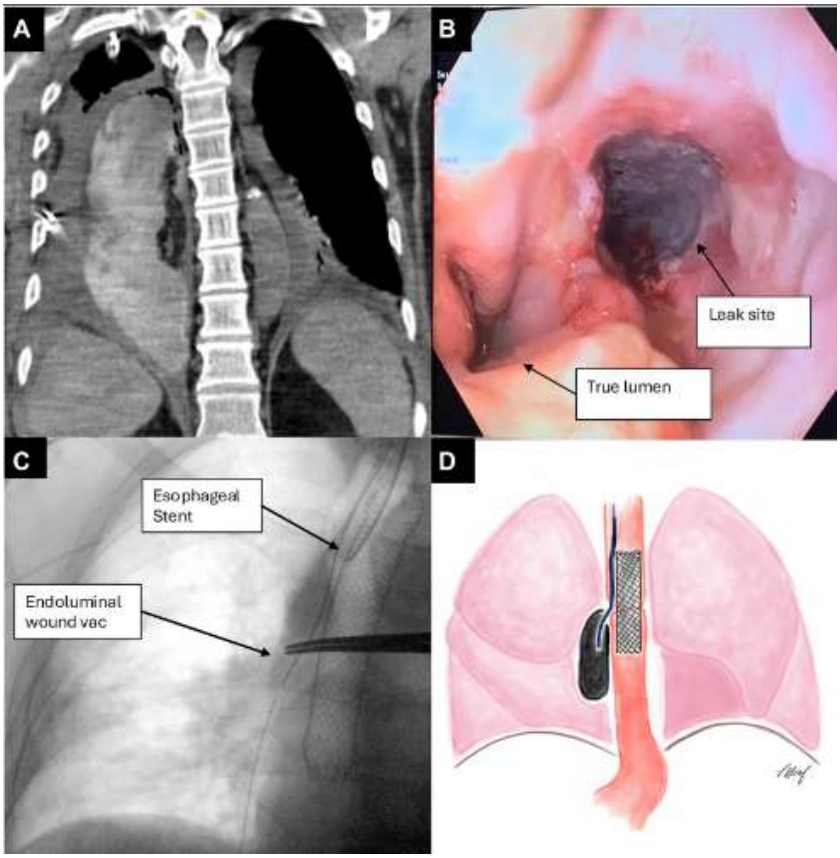


Figure 1. Endoscopic and fluoroscopic demonstration of the technique. (A) Scan demonstrates a large leak. (B) Endoscopic view of a partially treated large esophageal leak showing leak site and true lumen. (C) Fluoroscopy image of completed endoluminal wound vacuum and simultaneous esophageal stent. (D) Schematic of endoluminal wound vacuum and stent in place. [1]

The procedure done in this study used custom endoluminal VAC treatment tools with either 16F nasogastric tube or 19F Blake drain. (F = French size - It's a unit that measures the diameter (thickness) of medical tubes. 1 French = 1/3 millimeter) . The stent used was 23-mm × 105-mm or 23-mm × 155-mm and placed over the perforation sight. [1]

The reason for the placement of the stent was for the fact that a seal was created for the EWV within the leak cavity and thus allowed for the desired negative pressure for effective therapy. The stent essentially acts as the adhesive drape used in negative pressure wound therapy

for soft-tissue wounds. The stent additionally diverted saliva and gastric reflux away from the defect and leak cavity, which prevented further contamination while the EWV provided source control. [1]

Citations:

[1] S. S. Shankar, T. P. Hoof, M. P. Kim, W. C. Naselsky, and R. K. Chihara, “Simultaneous Endoluminal Wound Vacuum and Stent Therapy for Large Esophageal Leaks After Esophagectomy,” *Annals of Thoracic Surgery Short Reports*, Nov. 2025, doi: 10.1016/j.atssr.2025.10.013.

Conclusions/action items:

Stents are beneficial for patients with large esophageal leaks after surgery because they provide a minimally invasive treatment option for high-risk patients who are too sick for traditional surgery due to conditions like heart disease, kidney problems, or active infection. The stent acts like a tube-within-a-tube that creates a seal around the leak, allowing the vacuum sponge therapy to generate proper suction pressure (which doesn't work well on large leaks without the stent). It also diverts saliva and stomach contents away from the wound site, preventing further contamination while the area heals. Essentially, the stent functions like an adhesive drape in wound care - it covers the defect, enables effective vacuum therapy, and creates a protected healing environment, all while being placed through the mouth with a camera rather than requiring risky open surgery.

02/07/26 - VACStent Treatment Avoiding a Stoma in Lower GI

MARIAH SMEEDING - Feb 07, 2026, 11:35 AM CST

Title: VACStent Treatment Avoiding a Stoma in Lower GI

Date: 02/07/26

Content by: Mariah

Present: n/a

Goals: Understand how stents could be integrated into VAC therapy for the lower GI tract in the least invasive way possible.

Content:

This study began with 2 patients suffering from anastomotic leaks (AL), who were treated with the VACStent after stoma placement. Subsequently, 6 patients with AL were treated with the VACStent omitting a stoma placement, with a focus on fecal passage and wound healing. Finally, the preemptive anastomotic coverage was investigated in 4 patients with high-risk anastomoses to avoid prophylactic stoma placement.
In 2 patients, a dislodgement of a VACStent occurred, this seemed to be the largest issue present because every other treatment was successful.

AL are often found too late and without VAC treatment, they result in permanent stoma bag placements and in worst cases, extreme surgical intervention. [1]

EVTs give a minimally invasive procedure option that enables continuous drainage, limits the risk of sepsis, promotes granulation and is associated with reduced morbidity, mortality, and hospitalization rates. A significant disadvantage is that in more than 40% of cases, the stoma remains for the rest of the patient's life. [1]
The sooner the leak is identified and the sponge is placed, the better the patient outcome tends to be.

However, a major limitation of any sponge-assisted EVT system is that an endoluminal application within the colorectum is not feasible because it would occlude the bowel by obstructing the passage. Current treatment is an upstream anus praeter or artificial anus with placement of a stoma bag [1].

The VACStent consists of a self-expanding nitinol stent, covered with a silicone membrane and encased in a polyurethane-sponge cylinder, combining the benefits of EVT and covered stents. The ends of the covered stent contact the intestinal wall, sealing it from the lumen. A suction catheter embedded in the open-cell PU sponge is connected to an adjustable vacuum pump. Negative pressure created in the area of the sponge cylinder enables effective drainage as well as strong fixation of the VACStent to the intestinal wall [1].

Figure 1. left side VACStent Colon (inner diameter 25 mm), right side VACStent Oesophagus (inner diameter 12 mm)

The VACStent is placed by threading a guidewire through the anus up into the colon, then advancing the device over the wire while watching with a camera scope. Once positioned, a suction tube is connected through the anus to a vacuum pump set at -80 to -125 mmHg (continuous gentle suction). Before removal after 3-7 days, the sponge is flushed with saline solution and suction is stopped for 2-4 hours, then the device is pulled out using forceps that grab retrieval loops at its ends.

Citation:

[1] M. M. Heiss *et al.*, “Treatment of anastomotic leak in colorectal surgery by endoluminal vacuum therapy with the VACStent avoiding a stoma - a pilot study,” *Langenbecks Arch Surg*, vol. 409, no. 1, p. 234, Jul. 2024, doi: 10.1007/s00423-024-03426-5.

Conclusions/action items:

Previously, two methods existed but had significant drawbacks: covered stents lacked drainage and frequently shifted position, while sponge-based endoscopic vacuum therapy (EVT) required a temporary colostomy because suction would block the colon. The VACStent represents an innovation that combines the best of both approaches—it provides direct wound closure and allows fecal flow like a stent, while also offering the suction and drainage benefits of sponge EVT. The researchers tested the device in three patient groups: first, patients who already had colostomies and sponge treatment to prove the concept was safe; second, patients with new leaks and no colostomy to test real-world use (which led them to develop a larger 25mm diameter "Colon-VACStent" to allow easier stool passage); and third, high-risk patients who received the device preventively during surgery to potentially avoid needing a colostomy altogether. Despite the small sample size of 26 procedures limiting definitive conclusions, the results suggest the VACStent could potentially eliminate the need for temporary colostomies in many colorectal surgery patients, representing what the authors call a "paradigm shift" from aggressive surgical intervention to less invasive endoscopic management of complications.

02/13/26 - Tips and Tricks Upper GI VAC

MARIAH SMEEDING - Feb 13, 2026, 12:50 PM CST

Title: Tips and tricks for endoscopic negative pressure therapy

Date: 02/13/26

Content by: Mariah Smeeding

Present: n/a

Goals: Find what doctors do that works best when placing the VAC therapy, and what does not seem to go well during the procedure.

Content:

Initial examination:

- Always use CO2 insufflation instead of oxygen to inflate/expand the gastrointestinal tract during endoscopic procedures. This create space for visualization and allows the endoscope to navigate and see clearly. In the case where there is a perforation present: CO2 quickly dissolves into the bloodstream and is exhaled by the lungs where regular air can get trapped, cause complications, or spread through wounds. This lowers embolism risk.
- Use small endoscope initially to assess the wound if present and be as quick as possible.
- No debridement done initially, this is where dead and damaged tissue is removed. The wound must be assessed first to make it a quicker process when it is done because unnecessary tissue removal can cause more issues and spread bacteria. The debridement process is left for the VAC therapy to remove.

Two main placement techniques when wound is found:

1. **Intracavitary ENPT** (Into the cavity):

- Foam goes through the defect into the extraluminal space (outside the esophagus)
- Uses short foam pieces
- Goal: Collapse and empty the infected cavity completely.
- The sponge acts like a cork, sealing the opening while draining the cavity

1. **Intraluminal ENPT** (Inside the esophagus)

- Foam stays inside the esophageal lumen
- Uses long foam pieces (up to 12cm)
- Foam completely covers the defect zone
- The esophagus collapses around the foam under suction

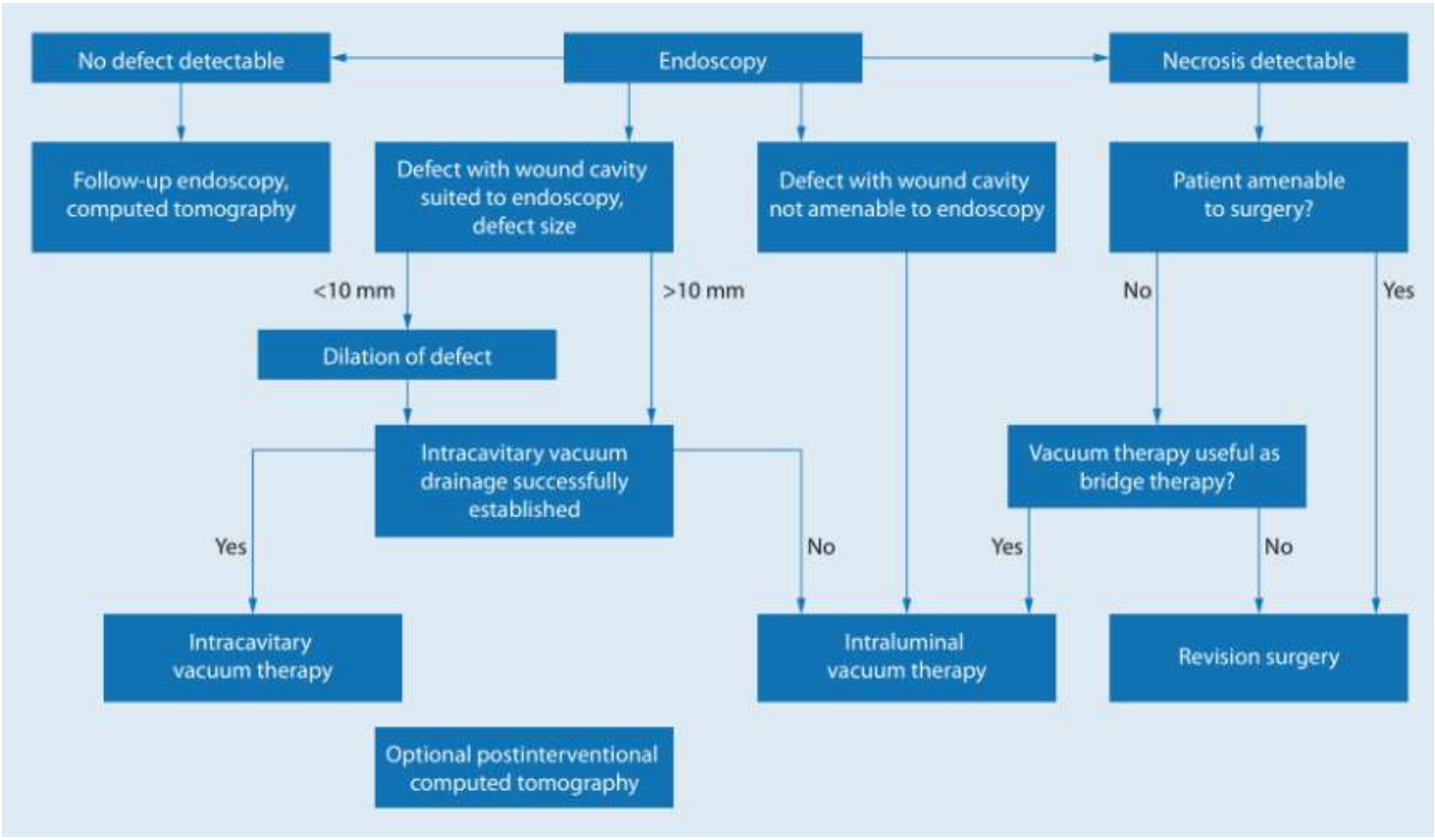


Figure 1. Flowchart showing treatment algorithm for endoscopic negative pressure therapy in the esophagus [1].

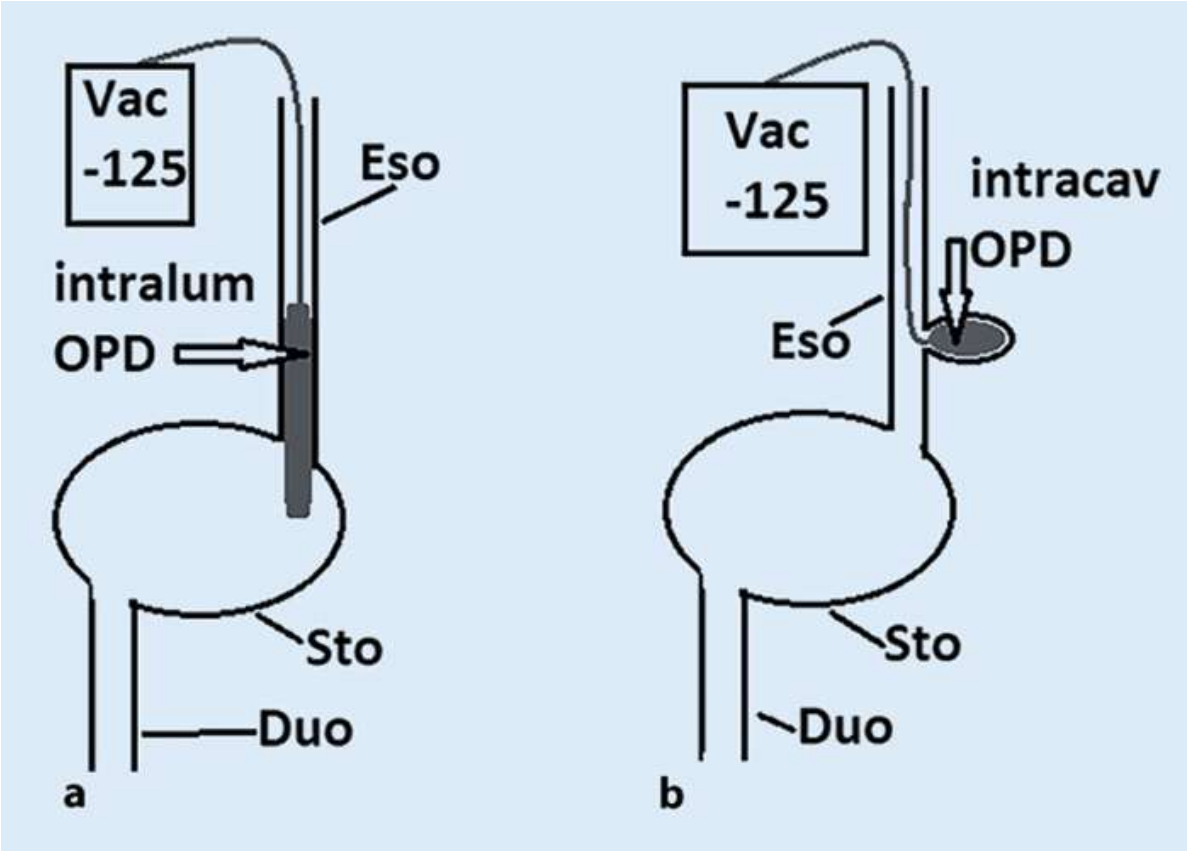


Figure 2. Visual explanation of the difference between intraluminal and intracavity VAC therapy techniques [1].

Placement techniques:

- Push: The open-cell drainage element (OD) is advanced to the desired location with an endoscopic grasper (e.g., polyp grasper, forceps) or along an over tube with a pusher or the endoscope
- Pull: The open-cell drainage element (OD) is advanced to the desired location with an endoscopic grasper or along an over tube with a pusher or the endoscope
- Pull-Through: The OD is pulled to the desired location along a preformed channel (e.g., an enterocutaneous fistula (an abnormal tunnel connecting the intestine (entero) to the skin surface (cutaneous)))
- Piggyback: A thread loop held with an endoscopic grasper is affixed to the distal end of the OD. The OD (riding on the back of the endoscope) is introduced together with the endoscope
- Rendezvous: Surgical placement of the OD
- Seldinger technique: The OD can be advanced to the desired location along a guide wire that has been endoscopically inserted beforehand
- Guide wire: A guide wire is inserted as a guide into the drain tube

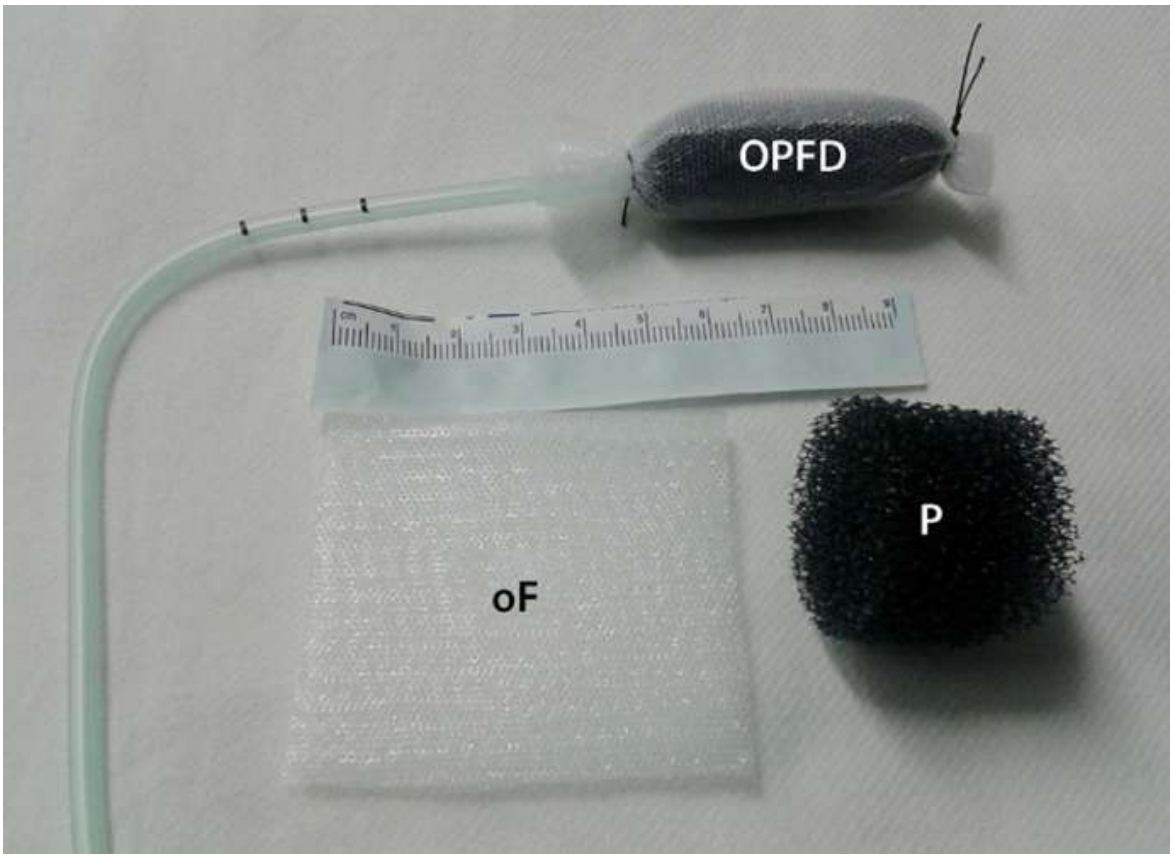


Figure 3. Wrapped polyurethane foam drain with open-pore film and polyurethane foam piece [1].

Citations:

[1] G. Loske and C. T. Müller, “Tips and tricks for endoscopic negative pressure therapy,” *Chirurg*, vol. 90, no. Suppl 1, pp. 7–14, 2019, doi: 10.1007/s00104-018-0725-z.

Conclusions/action items:

Placement techniques should be taken into consideration when designing our device. We should try to make these existing techniques easier to perform efficiently. Incorporation of both PU film and sponge may also be considered to reduce tissue integration and make removal easier.

03/26/26 - Testing Standards

MARIAH SMEEDING - Mar 27, 2026, 12:39 PM CDT

Title: Primary Testing Standards

Date: 03/27/2026

Content by: Mariah Smeeding

Present: n/a

Goals: To research main standards for testing biodegradable medical device coatings.

Content:

ASTM F1635 - In vitro degradation testing

- This test method is intended to help assess the degradation rates and changes in material or structural properties of hydrolytically degradable polymer materials used in surgical implants
- This would only be considered if we chose to try to work with polymer-based materials

Gelatin and sodium alginate are heavily researched and there are already studies that have proved they are biodegradability, biocompatibility and non-toxic. These are still things to keep in mind and should be referenced in final report.

ISO 10993-18 - chemical characterization

ISO 10993-13 - degradation product identification

ISO 10993-6 - implantation studies and biocompatibility testing

Conclusions/action items:

The ISO 10993 series standards are fully applicable to gelatin and sodium alginate and required for regulatory approval. Gelatin is FDA-recognized as GRAS (Generally Recognized as Safe) and both materials have established safety profiles in the literature, we can reference existing biocompatibility data to support our regulatory submissions. We can conduct ISO 10993-18 chemical characterization to identify all extractables and leachables from our specific coating formulation, ISO 10993-13 testing to identify and quantify degradation products (amino acids from gelatin breakdown and oligosaccharides from alginate degradation), and ISO 10993-6 implantation studies to assess local tissue response to our coated sponges.

03/26/26 - Testing Approaches

MARIAH SMEEDING - Mar 27, 2026, 12:36 PM CDT

Title: Testing Approaches

Date: 03/26/26

Content by: Mariah Smeeding

Present: n/a

Goals: Look into what degradation testing we should do

Content:

Enzymatic degradation testing - sodium alginate and gelatin degrade primarily through enzymatic mechanisms rather than hydrolysis (which polymers would degrade by)

- Protease testing for gelatin degradation in PBS solution (pH 7.4) - mimic the way that degradation would happen in the body. Measure how much as film has dissolved in time intervals [1].
- Alginate lyase testing for sodium alginate degradation - Alginate lyase cuts the chemical bonds in sodium alginate chains which break it up and allows it to dissolve away. This simulates how certain bacteria and body processes can break down alginate [2].

pH change response test - Sodium alginate/gelatin hydrogels are pH-responsive so we could use multiple pH testing conditions (not just 7.4) to assess how pH accelerates degradation rates.

Cross-linking density effects - Different cross-linking ratios significantly affect degradation rates

Swelling/water uptake testing - swelling capacity in different physiological fluids (water, saline, PBS, Ringer's solution) to understand how the coating behaves in different body environments [1].

Citations:

[1] O. Maikovych *et al.*, “Functional Properties of Gelatin–Alginate Hydrogels for Use in Chronic Wound Healing Applications,” *Gels*, vol. 11, no. 3, p. 174, Feb. 2025, doi: 10.3390/gels11030174.

[2] U. T. Do *et al.*, “Accurate detection of enzymatic degradation processes of gelatin–alginate microcapsule by 1H NMR spectroscopy: Probing biodegradation mechanism and kinetics,” *Carbohydrate Polymers*, vol. 304, p. 120490, Mar. 2023, doi: 10.1016/j.carbpol.2022.120490.

Conclusions/action items:

Sodium alginate and gelatin coatings require a modified testing approach compared to synthetic polymers, focusing primarily on enzymatic degradation mechanisms rather than hydrolytic breakdown.

02/08/26 - Sponge-Stent Design

MARIAH SMEEDING - Feb 09, 2026, 10:40 AM CST

Title: Design idea/considerations 1

Date: 02/08/2026

Content by: Mariah Smeeding

Present: n/a

Goals: To start brainstorming design concepts

Content:

Mechanisms that make vac therapy successful and should be considered when designing:

- Macro deformation: closure of defect
- Exudate control: drainage of pus and reduction of tissue edema
- Stimulation of perfusion: increased micro-vessel density
    - Transient reduction in blood flow in the surrounding tissues, leading to ischemia-induced release of growth factors and other vasoactive agents => angiogenesis
- Stimulation of secondary wound healing: micro deformation
    - Deformation of cytoskeleton => release of growth factors => increased expression of specific components and contractile elements necessary for healing

Potential drawbacks/technical issues to consider that have been noted by surgeons

- Sponge/pump dysfunction
- Clogging of the tube/VAC-Stent
- VAC-Stent dislocation

My design includes a polyurethane sponge and a stent. My idea was to combine Bostin Scientific WallFlex Biliary Plus stent into my design because it is an expandable fully covered metal stent that can be expanded and retracted multiple times in the GI tract to get the right position. It is made for the bile duct specifically so it is on the smaller side, which is perfect for this application. Shown in figure one is the WallFlex stent in action. The covered feature is particularly useful in this application because it can help create a seal between the damaged tissue of the anastomotic leak and the sponge, helping fluid drain out the catheter and promote tissue regeneration.

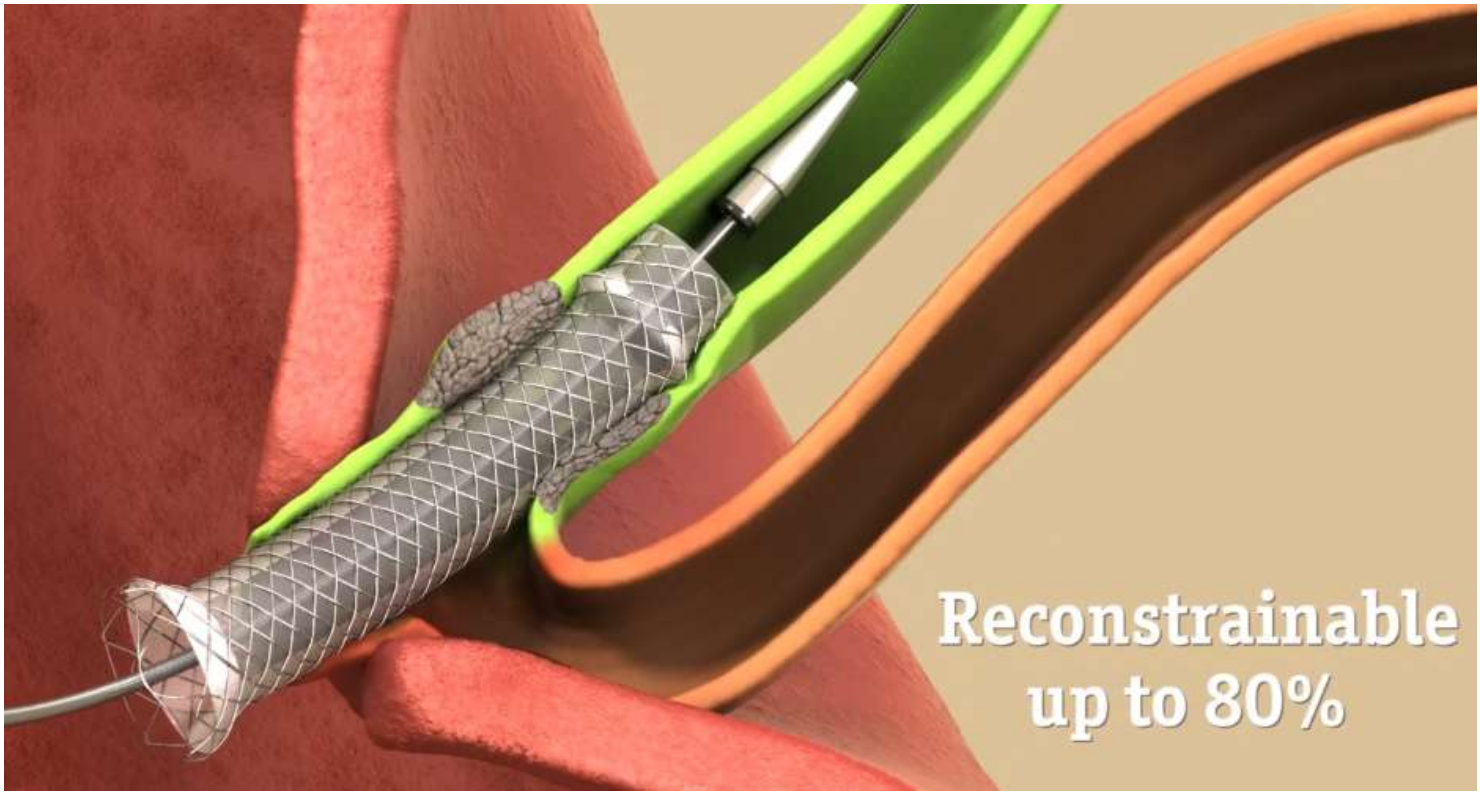


Figure 1. WallFlex Biliary Plus Stent deployed in the bile duct. You can see it has anti-migration features such as the distal flare and the proximal and proximal

bump. [1]

A polyurethane sponge would be designed to wrap around the stent and expand with the stent as it opens. The polyurethane sponge has great success in treating these GI leaks and may be good to include however we are not limited to PU. If another material that's better arises, we may go with that.

I have included the link to my design sketches below this entry in hopes the quality would be better.

In this design, the PU sponge will be embedded with Gold nanoparticles and there are several methods to do so:

- First, you have to make the PU conductive. I have seen two approaches so far in one article [2]:
  - CB approach: CB (carbon black) is essentially very fine carbon particles. When you coat PU sponge with CB, you're creating a thin conductive layer of these carbon particles across the entire sponge surface. CB has functional groups (-COOH, -OH) on its surface that can anchor nanoparticles. CB is more commonly used in medical applications and has a simpler process of coating [2].
  - MXene approach: MXene has a layered 2D structure with lots of surface functional groups (-OH, -F, -O) that help anchor gold nanoparticles [2].
- If going with CB -
  - You'd first coat the PU sponge with CB by dipping it in a CB suspension (often stabilized with a polymer like PVP to prevent aggregation), then drying it to create a conductive carbon layer throughout the porous structure. Once conductive, you'd immerse the CB-coated sponge in a gold salt solution (like chloroauric acid) and apply an electrical current [2].
  - This electrodeposition process reduces the gold ions to metallic gold nanoparticles that deposit directly onto the carbon surface. The electrochemical bonding creates strong attachment between the Au NPs and the carbon substrate, preventing the nanoparticles from washing away under the negative pressure and fluid flow conditions in a EVAC system [2].
- Another article researches the methods of Polydopamine-Carbon Black Coating Process [3] [4]:
  - Immerse clean PU sponge in dopamine solution (typically 2 mg/mL dopamine hydrochloride in Tris buffer, pH 8.5) [4]
  - Self-polymerization occurs at room temperature for 12-24 hours [4]
  - The alkaline environment (pH 8.5) triggers dopamine to polymerize into polydopamine [4]
  - Carbon Black can then be deposited as the PDA acts like a glue that creates covalent and non-covalent bonds between the PU skeleton and CB nanoparticles by dipping the PDA-coated sponge into CB suspension. [3]
  - Finally, gold nanoparticle electrodeposition onto the conductive CB layer [2]

Citations:

[1] “WallFlex Biliary PLUS RX Stent System,” Boston Scientific. Accessed: Feb. 09, 2026. [Online]. Available: https://www.bostonscientific.com/us/en/healthcare-professionals/products/stents/biliary-and-pancreatic-stents/wallflex-biliary-plus-rx-fully-covered-stent-system/fp90000111.html

[2] S. Wang, G. Wang, H. Shi, A. Jing, and G. Liang, “Flexible three-dimensional Au/MXene/CB/PU scaffold for electrochemical sensing and real-time monitoring of cellular hydrogen peroxide release,” *Microchemical Journal*, vol. 220, p. 116292, Jan. 2026, doi: 10.1016/j.microc.2025.116292.

[3] Y. Huang, X. He, L. Gao, Y. Wang, C. Liu, and P. Liu, “Pressure-sensitive carbon black/graphene nanoplatelets-silicone rubber hybrid conductive composites based on a three-dimensional polydopamine-modified polyurethane sponge,” *J Mater Sci: Mater Electron*, vol. 28, no. 13, pp. 9495–9504, Jul. 2017, doi: 10.1007/s10854-017-6693-0.

[4] S. Wang *et al.*, “Superhydrophobic carbon black-loaded polyurethane sponge for efficient oil-water separation and solar-driven cleanup of high-viscosity crude oil,” *Journal of Water Process Engineering*, vol. 53, p. 103812, Jul. 2023, doi: 10.1016/j.jwpe.2023.103812.

Conclusions/action items:

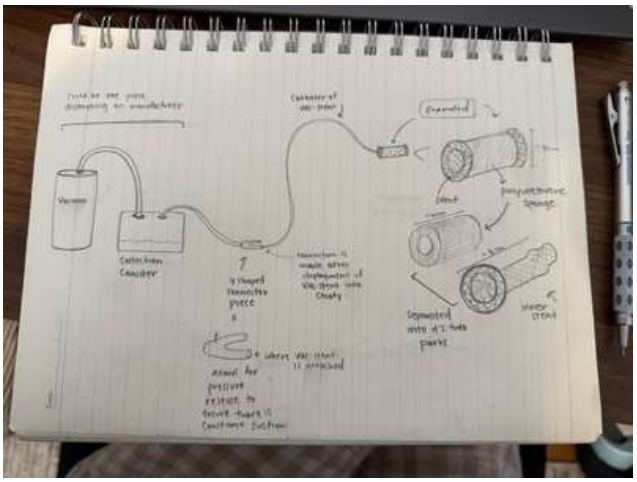
I need to continue research on if any of these methods of embedding gold nanoparticles into the PU sponge would be possible for our team to do with the resources available to us.

The process workflow includes:
PU -> conductive coating -> gold NP electrodeposition

Article [3] describes the PDA modification + CB coating process

Article [4] states "Huang et al. used dopamine to form polydopamine by self-polymerization in a slightly alkaline solution. They prepared sponge sensors by adhering CB nanoparticles and graphene nanosheets to polyurethane sponges through the adhesion effect of polydopamine." This describes the pH 8.5 Tris buffer protocol and is needed for the polydopamine (PDA) coating step because it's what triggers dopamine to self-polymerize and stick to the PU sponge surface which gives CB a surface to adhere to.

Article [2] states ""By coating the sponge with an MXene/carbon-black (MXene/CB) hybrid layer and subsequently electrodepositing gold nanoparticles (Au NPs), we constructed a 3D electrochemical platform"" and describes the process of coating the gold nanoparticles onto the sponge.



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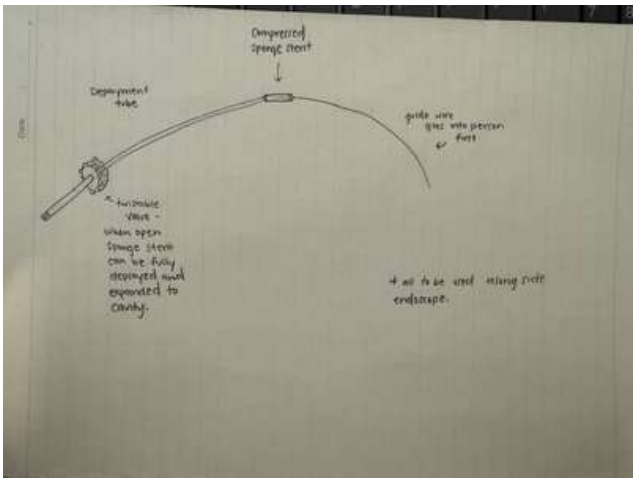
sponge-stent.jpg (561 kB)

MARIAH SMEEDING - Feb 09, 2026, 9:27 AM CST



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Sponge-stent2.jpg (358 kB)

02/09/26 - Integration of Gold or Silver Nanoparticles to PU

MARIAH SMEEDING - Feb 09, 2026, 9:52 AM CST

Title: Integration of Gold or Silver Nanoparticles to PU

Date: 02/09/26

Content by: Mariah Smeeding

Present: n/a

Goals: To learn how to imbed PU with nanoparticles for their antimicrobial properties. It has not be incorporated into a stent and sponge design thus far and may be promising.

Content:

This article looks at incorporating gold nanoparticles into PU sponge.

- They coat PU sponge with MXene/carbon black (CB) hybrid layer first
  - this provides conductivity which is needed for electrodeposition and it provides structural stability
- Then electrodeposit gold nanoparticles onto that conductive layer
  - The Au particles have antimicrobial properties
- This creates strong anchoring of Au NPs and avoids the leaching problem
  - Au anchors very strongly to the MXene so they are low probabilities of particle migration

This paper focuses on H_2O_2 sensing which is not something that is applicable for endoVAC treatment however this method could still be used for the antimicrobial properties of gold particles.

Citations:

[1] S. Wang, G. Wang, H. Shi, A. Jing, and G. Liang, “Flexible three-dimensional Au/MXene/CB/PU scaffold for electrochemical sensing and real-time monitoring of cellular hydrogen peroxide release,” *Microchemical Journal*, vol. 220, p. 116292, Jan. 2026, doi: 10.1016/j.microc.2025.116292.

Conclusions/action items:

This is something that should be considered in our designs, incorporating gold nanoparticles to a PU sponge.

02/11/26 - Sponge-Stent with Balloon

MARIAH SMEEDING - Feb 11, 2026, 1:14 PM CST

Title: Sponge-Stent with Balloon

Date: 02/11/26

Content by: Mariah Smeeding

Present: n/a

Goals: To come up with another device idea, more focusing on deployment of the EVAC system.

Content:

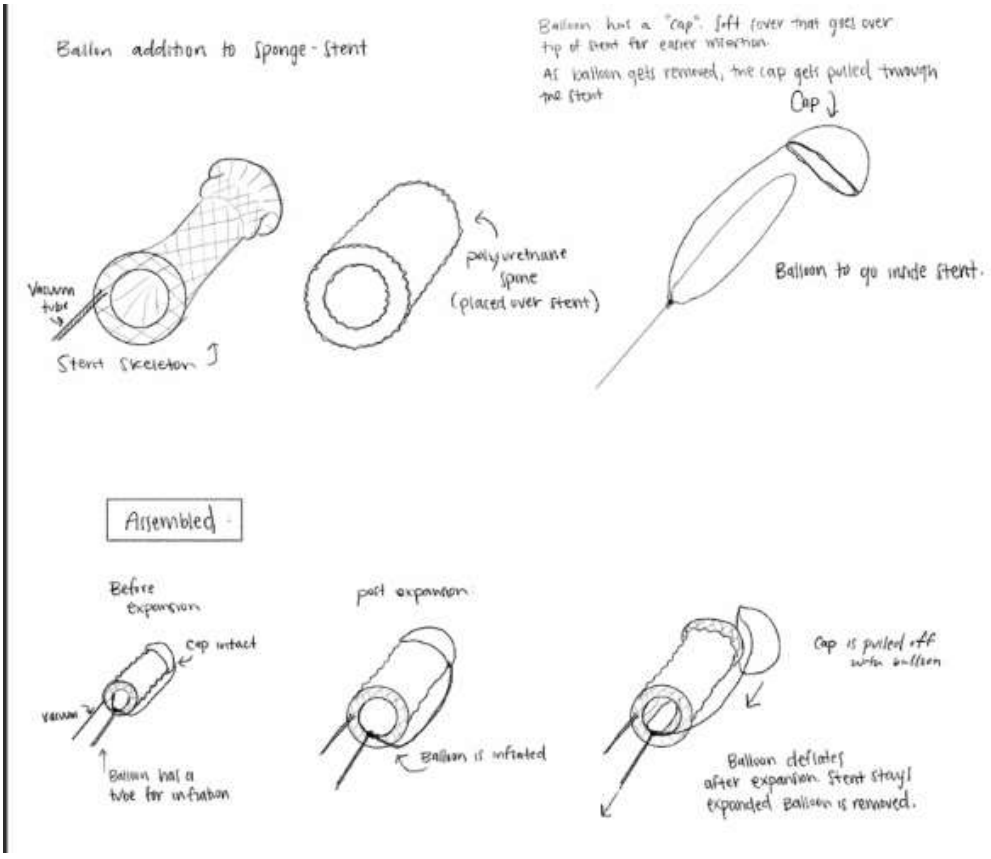


Figure 1. Rough sketch shows device components on first row and assembled device on second row with ballon deflated and balloon inflated.

This design uses a stent and sponge set up however it has the addition of a balloon to assist in the expansion of the device in the cavity. It also has a cap attached that will cover the top end of the device that is inserted into the GI tract first. This will make the device slide to the cavity easier and hopefully make placement less obstructive. The cap will be attached to the balloon by a thread so that when the balloon gets pulled out, the cap will come off with it. This may be an issue due to the potential of the cap getting stuck onto the expanded stent/sponge. Another consideration I had was maybe it would be better if the cap could be pulled through the center of the stent after it has been expanded inside the cavity. I am thinking that it will be made out of latex, rubber, or silicon. Something flexible and slippery inside the body.

Conclusions/action items:

Speak with team about other design ideas and choose the three most promising for design matrix. Rank the top three based on predecided criteria and choose a winning design by 02/12/26.

03/18/2026 - Cryogen Chemical Safety Training Certification

MARIAH SMEEDING - Mar 18, 2026, 3:21 PM CDT

Title: Cryogen Chemical Safety Certification

Date: 03/18/26

Content by: Mariah S.

Present: n/a

Goals: Completed training from spring 2025 to spring 2026

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

This certifies that Mariah Smeeding has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/28/2025	1/28/2030
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	3/14/2026	3/14/2031
Chemical Safety: The OSHA Lab Standard	Final Quiz	1/27/2025	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/29/2025	10/29/2028

Data Last Imported: 03/18/2026 02:56 PM

Conclusions:

Part 1 final quiz complete is shown. Part 2 final quiz has been complete, yet it has not showed up on the website yet. This entry will be updated when the website shows my completion.

01/28/26 - Lecture 1

MARIAH SMEEDING - Jan 28, 2026, 2:06 PM CST

Title: Library Session 1

Date: 01/28/26

Content by: Mariah Smeeding

Present: n/a

Goals: How to research effectively and efficiently

Content:

Different technologies to know:

- Online search engines
- LLM Chatbots
    - They are predictive text generators, not search engines
    - Can give false information
    - Trained with undisclosed data they may not be factual and current info and may also be biased.
- Databases
    - Use one provided by UW library
    - Ability to narrow down a lot or a little depending on what you want to research
    - Scopus could for an initial general search on desired topic
        - option to add in ranges and keywords to narrow down the articles given
        - good to look at author key words to understand how that paper is described and how to search for other similar articles.

Zotero - citation manager

- Helpful for organizing sources and make it possible to create easy citations and ability to share sources with others in a shared library folder
- Not only is there a wiget on web browser, but there can also be a wiget added into word.

Evaluating Sources

- Relevance - what's it about?
- Authority - who created it?
- Quality - why was this written and how does it affect the information?
- Currency - when was this source created?

Technical Report

- Government funded research. The research is performed and reports are produced by companies, universities and government labs
- These are usually very current, and the info is about directly what happened in lab, the good and the bad.
- Not peer reviewed
- Recommended databases:
    - DTIC
    - NTRL
    - OSTI

Conclusions/action items:

Make sure to fact check any information gotten from AI models. The information they give can sometimes be false and not come from a proper source. It is important to cite all sources that are used and Zotero makes that process very easy.

Find 4 new sources using the researching techniques discussed in class. Create entries for the sources in Lab archives and properly cite them.

Note that next week, must bring in two printed copies of resume, cover letter, and job posting of interest to class.

- Options to consider:
    - BU lab
    - UC boulder summer research
    - Eckhardt Lab on campus

20/04/26 - Lecture 2

MARIAH SMEEDING - Feb 06, 2026, 2:27 PM CST

Title: Resume and Cover Letter Review

Date: 02/04/26

Content by: Mariah Smeeding

Present: N/a

Goals: To review fellow student resumes and cover letters and get my resume and cover letter reviewed.

Content:

In class we were asked to assess other students resume, cover letter, and the specific job posting they are applying to. We reviewed their work based on a rubric. This rubric had questions that asked the relevance the resume had to the job posting. If keywords were including and if the background and skills of the student matched with what the job entails. It asked how the cover letter came across and how genuine they sounded.

This exercise was helpful because it gave me real insight on how a resume is assessed. It also allowed me to see other students resumes and what everyone else is putting on theirs.

My reviews:

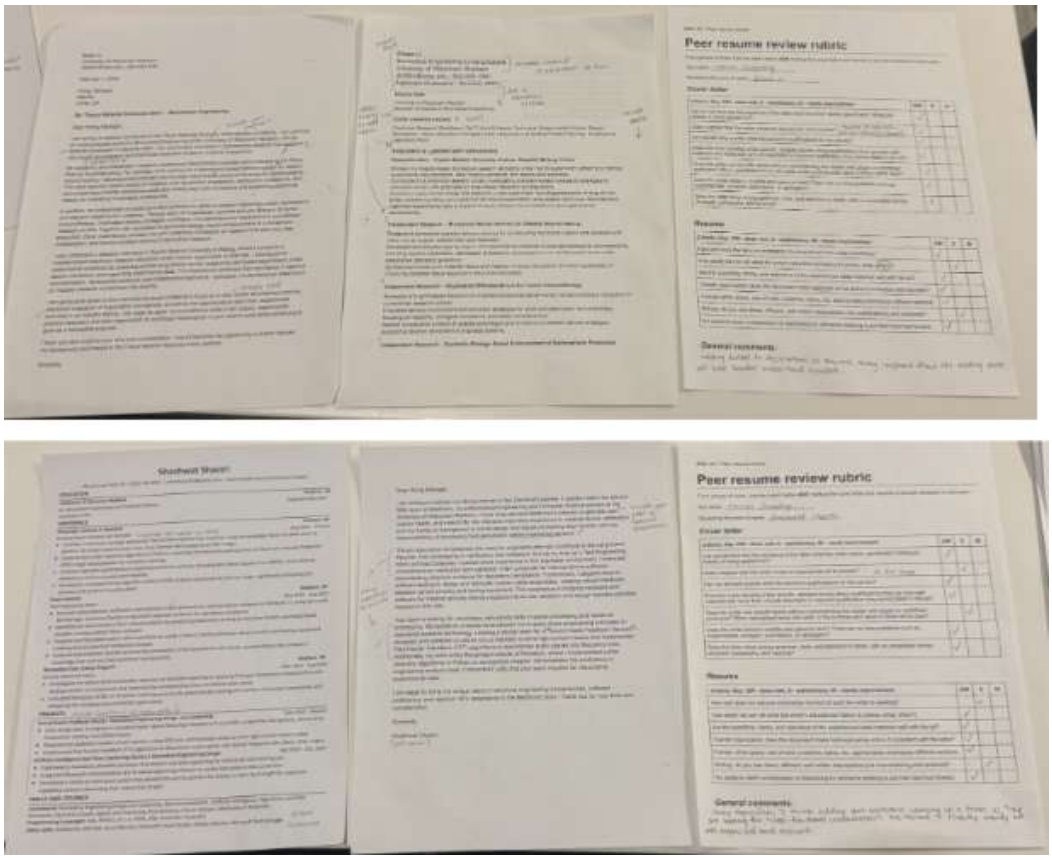


Figure 1. Upper - My reviews for Zhiao's work. Lower - my reviews for Shashwat's work.

Conclusions/action items:

I should consider moving my professional experience titles to the same line as the company associated so I can have another line of space to describe what I did in those roles. It was also brought to my attention that I could explain more my role as the team leader of biomaterials in the bone cyst project. Shashwat gave me some advice about my cover letter as well and said I could cut out a sentence to be more concise and it was helpful feedback because I don't think I would've considering doing so.

02/11/26 - Lecture 3

MARIAH SMEEDING - Feb 11, 2026, 1:40 PM CST

Title: Presentation Tips and Job Interviews

Date: 02/11/2026

Content by: Mariah Smeeding

Present: n/a

Goals: Review how to give an effective presentation and learn how to get better at interviews.

Content:

- Presentation tips
  - Be consistent with font style
  - Bullets should be neat - no single hanging bullets, all should be aligned on the left.
  - Logical flow - may not be in the order things were done in
  - Design ideas should be presented in the same order throughout and make it easily comprehendible.
  - Do not use pictures you will not discuss
  - 6x6 rule of thumb - don't be too wordy
  - Keep audience interested and engaged (try your best). Keep it relevant - why is it important. Be excited and respectful
  - Design Matrix
    - when presenting just give the highlights because you can't cover everything. Highlight the winning scores
  - Figure captions should always be present and cited if needed. Figure X. blah blah [1].
  - Graphics - don't use high dimensioned CAD drawings. Give one image that shows everything that well labeled and clear. scale bar!
  - Results - always graph it, do not show raw data. use comparable axis values.
- Job Interviews
  - Guidelines:
    - Bring a small portfolio (includes design projects, resume, etc.)
    - Be specific and personal to stand out among other BMEs - such as undergrad research, FDA knowledge, student assistant roles, design projects.
    - Technical skills AND soft skills like communication!
    - Be prepared to answer common questions
    - Research the specific company
    - Ask thoughtful questions
  - Activity: pick three questions and type responses. Share with group of thee. Reflect on each others answers.
  -

Conclusions/action items

- Initial Design matrix is due tomorrow, 02/12/26
- Presentations are coming up - bring copy of slides next week for peer review (all printed on one page)
- Next Friday is presentation.

02/18/26 - Lecture 4

MARIAH SMEEDING - Feb 18, 2026, 1:34 PM CST

Title: In Class Peer Review of Preliminary Presentation Slides

Date: 02/18/2026

Content by: Mariah Smeeding

Present: n/a

Goals: Review presentation slides.

Content:

Pair up with another team to switch slides with. Discuss presentation and make annotations.

Conclusions/action items:

Prepare for preliminary presentation on Friday 02/20

Peer and self-evaluation due before report

Preliminary Report due next Wednesday 02/25

02/25/26 - Lecture 5

MARIAH SMEEDING - Feb 25, 2026, 1:52 PM CST

Title: Diversity and Inclusion in Design

Date: 02/25/26

Content by: mariah smeeding

Present: n/a

Goals:

Content:

What does diversity mean in engineering design?

- Inclusive considerations when making design decisions (ie multicolored band aids in marketed as 'skin toned')
- Be aware of differences in certain ethnicities/races and how the device may affect the consumer (ie African American lineage has sickle cell more commonly)
- Open-mindedness to all ideas and contributions
- keeping in mind different religious practices and beliefs
- active listening
- acknowledging different backgrounds because it brings new perspective to the team
- socioeconomic status
- culture
- what you ate for breakfast...

Universal design

- inclusivity in design considerations
    - religion
    - race
    - age
    - ethnicity
    - geographical
    - socioeconomic
    - disability
        - blind
        - deaf
        - cant walk
        - cant eat on their own etc.
    - gender
- design should be adjustable/flexible to meet these needs and differences
    - simplistic
    - user friendly
    - ergonomical
    - broad demographic in testing

7 principles of universal design

1. Equitable use
2. Flexibility in use
3. Simple and intuitive
4. Perceptibly Information
5. Tolerance for Error
6. Low Physical Effort - ergonomics
7. Size and Space for Approach and Use

Ethics

- Good intentions
- testing with a broad demographic

Conclusions/action items:

Identification of components of our design that could be more universal lecture activity is under team activity folder.

Pre-lecture activity for next class.

03/04/26 - Lecture 6

MARIAH SMEEDING - Mar 04, 2026, 1:56 PM CST

Title: Library Session 2: Patents, Standard, and Other Resources for Design

Date: 03/04/26

Content by: Mariah S

Present: n/a

Goals: Hear from Dave Bloom

Content:

Standards

- Libraries have full text available: ASTM (including ISO and IEC), ASABE, IEEE
- Freely available online: ASSIST quick search, EverySpec, FDA, NASA, NFPA, etc.

Market Industry/Databases

- Data Axle Reference Solutions - business, demographic, and lifestyle information on consumers
- IBISWorld Industry Reports - inputs and outputs of industry, economic info
- ProQuest One Business - scholarly articles, journals, dissertation; all business focus

Patents

- Evaluation based against prior inventions. What else is out there? Is your product unique?
- Lens.org - good database for finding patents

Conclusions/action items:

Tong Award - requires a business side and reports associated

03/06/26 - Tong Lecture

MARIAH SMEEDING - Mar 06, 2026, 8:14 PM CST

Title: Tong Distinguished Lecture

Date: 03/06/36

Content by: Mariah S

Present: n/a

Goals: Hear from Justin Williams

Content:

Dr. Williams gave an impressive speech about his life, how he made it into the field of biomedical engineering, and projects he has been working.

He highlighted how he grew up in a rural community and was not handed many opportunities. The reason he was able to attend college was because he was a fast runner and made it on a sports scholarship. He went on to pursue his bachelor's in mechanical engineering and then worked at Daktronics. He realized after a close friend of his died from a traumatic brain injury that he wants to help solve issues that involve the body, that is when he learned about BME. He went to get his master and later his PhD in Biomedical Engineering and started his first projects. His first few products he helped produce were not hits and ended up failing to make it to market. He highlighted this experience as normal; its normal to make something that does not go anywhere. He did not stop there and kept creating. He took past ideas and designs and looked where else they could be most helpful. His persistence lead him to successful designs and he is currently creating breaking edge treatments for stroke patients.

His projects have focused on developing technologies for treating ALS, Stroke patients, Epileptic Patients, and other neurodegenerative disorders. He did this with electrode arrays to stimulate brain regions of interest in very controlled ways. He then spoke about brain physiology and what the glymphatic system is and why it is crucial to brain health. I found this particular intriguing especially when he highlighted how important sleep is. When we sleep, our brain clears away toxins and prevents build ups of unwanted proteins called tau proteins. This discovery lead him to his most recent project Briansync. A way to simulate the glymphatic system to help treat patients whose brains cant properly clear the toxins on their own which lead to cognitive decline.

Conclusions/action items:

Justin Williams is currently working to create cutting edge technology to help clear toxins from the brain. Essentially, helping to activate the glymphatic system. I found this speech to be very interesting and most impressive. I am very excited to see how Brainsync does in the future and to see how many people this could help. My grandma is currently suffering from cognitive decline; it is a horrible disease and to know that treatments like Brainsync are being produced to help patients like her make me overjoyed.

03/11/26 - Lecture 7

MARIAH SMEEDING - Mar 11, 2026, 1:46 PM CDT

Title: Product Development

Date: 03/11/26

Content by: Mariah

Present: n/a

Goals: Become aware of what goes into good/well thought-out protocols for your design

Content:

Fail fast and early:

- Low fidelity - cardboard, etc.
- Start early!
- Test individual pieces

Preliminary testing/analysis:

- Such as low fidelity prototyping
- Fittings - specify connection points
- Simple Calculations
- Free body diagrams
- mechanics of materials

Planning general concepts for fab and testing

- Materials - detail list = match material expense table + more
    - name of material
    - conc., amount or starting dimensions
    - manufacturer and part number
    - purpose of material
    - list of needed equipment
    - references
- Methods - step by step guide
    - Mix - for how long and what vigor
    - cut - with what tool and what size
- Rule #1 - give it someone else and make sure its repeatable to an unfamiliar reader
- For 3D printing make sure to list materials, note the methods - printer settings and the gCode!

Manufacturing

- Consider throughout the process
- you can't manufacturer everything that you 3D print
- Common methods
    - molding - blow, injection, thermoforming, extrusion
    - machining - mill, lathe, waterjet
    - joining - welding, soldering, screwing, riveting, adhesives
- Seek professional advice
    - design innovation labs (Jesse D)
    - Use experts in the field - faculty (Dr. Ohnsorg)

Fabrication Plans

- Details of every single step
- When will it be completed

- Who will be completing it
- Should have sketches with labels
- How will it be fabricated

Testing Plan - additional considerations

- Think about statistics before you start
- what controls are needed?
- do you have to design something to ensure precision and accuracy?
    - test fixture for MTS
    - Apparatus to hold items in a fixed position for motion capture, etc.
- Reference the PDS!
- Testing plan should match fabrication plan

Conclusions/action items:

When making protocols, more detail the better.

Create your own protocol.

03/18/26 - Lecture 8

MARIAH SMEEDING - Mar 18, 2026, 1:41 PM CDT

Title: Show and Tell/ Poster Session Prep

Date: 03/18/26

Content by: Mariah Smeeding

Present: n/a

Goals: Prepare for show and tell and begin to think about poster presentation

Content:

Elevator Pitch:

- Effectively communicate your ideas quickly
- Capture attention
- generate interest
- leave with something interesting
- You should:
  - Know your audience - tailor to audience
  - Practice
  - Be authentic, keep it simple
  - Adapt and iterate, use feedback
- General structure:
  - Hook - developed a device to what
  - Introduction - hi, im mariah our project..
  - Value proposition - currently no tech available
  - Benefits - estimated that X people would benefit has a potential market for $
  - Call to action - next steps and questions
- Do's
  - Eye contact
  - Focused and short
  - Tailor speech to different audiences
- Don't
  - unnecessary details
  - listen and engage with audience
  - don't sound over rehearsed

Executive Summary

- Essentially and elevator pitch put into a one-page document
- Saying more with less, not about just saying less

Abstract

- Finish it last
- Typically, 150-300 words
- Summary of the work over entire semester

Technical reports

- Eliminate extraneous text
  - remove redundant pairs (ex. end result, important essentials, basic fundamentals)
- avoid conversational text
- Spell out acronyms once when first introduced
- no raw data

- proofread thoroughly, all the way through it should read as if one person wrote it

Conclusions/action items:

Discuss with team which award we will run for: tong or design excellence award

Develop pitch and complete call to action for show and tell

03/25/26 - Lecture 9

MARIAH SMEEDING - Mar 25, 2026, 2:09 PM CDT

Title: Ethics in Engineering

Date: 03/25/2026

Content by: Mariah Smeeding

Present: n/a

Goals: Review a case study with the team

Content:

Where do ethics come from?
- Religion
- Family
- Friends
- Academics
- Work

Is there a difference in between "personal" ethics and "professional" ethics?
- Personal ethics comes from how you were raised, what morals you grew up knowing was correct. Personal ethics may have to do with yourself more, more creative.
- Professional ethics has to do more with others around you, how to 'keep it professional', learning to work on a team effectively, working for others with their needs in mind.

Ethical decision-making process (be aware):

- Awareness
- Stakeholders
- Options
- Analysis of options
    - Harm test
    - Publicity test
    - reversibility test
    - Universality test
    - Respect of person test
    - Utilitarian test
    - Social Justice test

Medical Device Dilemma: BME 301 - Ethics in Engineering - Google Docs

1. **The Guidant VPs**: Most of the VP's at Guidant are very much against reporting the data to the FDA. (a) How might they continue to justify their case? (b) What would be the moral foundations of their perspective?

I think they are continuing to justify their case because there are many people that are benefiting from this device even though the chance of complications is high. For some, it may be the case that this device is providing a handsome income, and they do not want that to go away.

1. **Patients and doctors**: Think about the position of those directly impacted: primarily patients who might be candidates for this surgery, and the doctors who use the device: (a) what arguments would those people want to ensure are considered by both the VPs and the design engineers about whether to report or not report the complications data? (b) What might be the ethical foundations of their perspective?

I am positive that would want this device to be extensively tested and revised to reduce chance of complication. They would also want honesty, even if there are high complication rates. Some patients may even still want the device placed even if they knew how great of a chance of failure, it may be better than their current situation. However, it should be an ethical moral to tell the truth of a medical device to fully inform the doctor and the patient, so they are aware of every risk they make be facing.

1. **The design engineers**: (a) What else can they say or do? (b) What arguments can they try to make, and to whom?

This is tough. They do not want to lose their jobs, but I am sure many do not morally agree with how the information is currently being disclosed.

1. **The design engineers**: What options do they have? Generate a list of possible options (a minimum of 3 from the perspective of the design engineers), describe how each stakeholder is affected, then analyze them using the BME Code of Ethics (https://www.bmes.org/2025/cmbeconference/codeofconduct) and a couple of tests from the ethical decision-making system. Explain in detail the best option you would consider trying to act on.

Well they could go to compliance offices and VPs but they already did.
Could they go to the FDA? Would they go to a lawyer?

What components of your design have ethical dimensions?
- Our design is to be inserted inside someone's esophagus. It is a very intrusive procedure so there are many ethical dimensions to consider.
- Gelatin form pigs may be a concern
- Procedure related: how the device will get placed.
-Material consideration: truly biocompatible?
- Comfort: this device is inserted for long periods of time

How will your team address the ethical dimensions?
- Make it clear what the materials are made of
- Confirm that device can be inserted easily and accurately with many tests on real esophagus models
- Biocompatible testing on pig esophagus
- Degradation testing: ensure the material we choose will completely degrade

Conclusions/action items:

Consider what morals align with me and what I want to carry throughout this project and my career.

04/08/26 - Lecture 10

MARIAH SMEEDING - Apr 08, 2026, 2:09 PM CDT

Title: Engineering Judgement

Date: 04/09/2026

Content by: Mariah S

Present: n/a

Goals: How to make engineering judgments

Content:

Know when it is okay to round and make rough approximations.

How do you get the skills?

- read world engineering problems
- open ended questions
- teamwork and collaboration
- communication skills
- critical thinking - evaluation solutions
- ask questions
- handling uncertainty

Conclusions/action items:

Completed the engineering judgement assignment as a team during lecture.

Meeting with Dr. P on Friday.

04/15/26 - Lecture 11

MARIAH SMEEDING - Apr 27, 2026, 8:37 PM CDT

Title: Poster Presentations

Date: 04/15/26

Content by: Mariah Smeeding

Present: n/a

Goals: Learn how to put together a great poster for presentations.

Content:

What makes a poster good?

- When it's not overwhelming with words
- Has good colors
- Consistent font size
- Label figures
- Gets to the point quickly, someone reading it over quick knows what the point of the project is

What makes a bad poster?

- Small font - including the numbers on the graphs
- weird fonts
- raw data
- unexplained data/pictures (no figures)
- a lot of words
- redundancy

Conclusions/action items:

Prepare a poster draft to bring into class next week for peer review!

04/22/26 - Lecture 12

MARIAH SMEEDING - Apr 27, 2026, 8:39 PM CDT

Title: Poster Peer Reviews

Date: 04/22/26

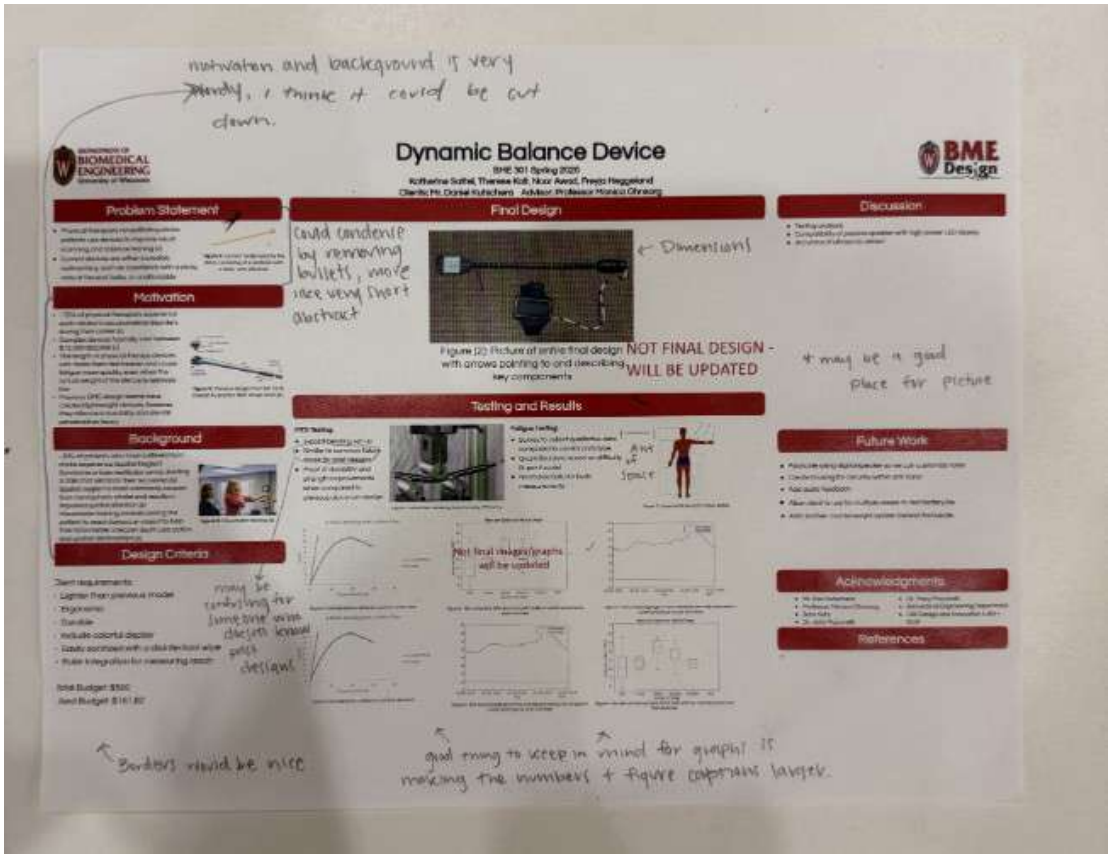
Content by: Mariah Smeeding

Present: n/a

Goals: Get my poster reviewed and review someone elses poster

Content:

The poster I reviewed:



Conclusions/action items:

Feedback our team got was to make the numbers on our graphs bigger, so I will do that in Matlab.
We also want to include different final design pictures and better biomaterial pictures to show the gel films we have been making more clear.

Get ready for presentation on friday!

01/28/2026 Library 1 Lecture

SIMON FETHERSTON - Jan 28, 2026, 1:52 PM CST

Title: Library 1 Lecture

Date: 01/28/2026

Content by: Simon

Present: N/A

Goals: Attend lecture and learn about library resources

Content:

Online search engines vs LLM chatbots vs databases

- OSE - produce a results list
- LLM - produce predictive text

AI as a research tool

- predictive
- do not evaluate credibility or bias
- can generate factual incorrect statements
- do not consistently respond

How to get an accurate search

- Utilize operands to narrow search terms (AND)
  - databases may have search boxes to specify search (keywords, filters)
- Keywords
  - Author and indexed keywords
  - Can follow group keywords

USE A CITATION MANAGER

- Zotero
- Use IEEE

Evaluating Sources

- Relevance - what is the source about?
- Authority - who created this?
- Quality - why was this written and how does that affect the information?
- Currency - when was this source created?

Technical report - publish the results of scientific or technical research, often using federal funds. The research is performed and reports are produced by companies, universities, and government labs. Can show problems that went wrong and any issues that occurred during experimentation

Conclusions/action items: This lecture was useful for reinforcing my ability to find and evaluate accurate and reliable sources. While I conduct research on my topic, I will make sure to utilize keywords. This will be especially important when research EVT. I can use keywords to find articles on specific procedures or aspects of the procedure, such as the tools used. Instead of constantly searching endoluminal vacuum therapy, I can use specific keywords like physiology, materials, or endoscope, to narrow down searches that can be useful for my project.

- Continue to conduct preliminary research using library resources

02/04/2026 Resume and Cover Letter Review

SIMON FETHERSTON - Feb 04, 2026, 2:51 PM CST

Title: Resume and Cover Letter Review

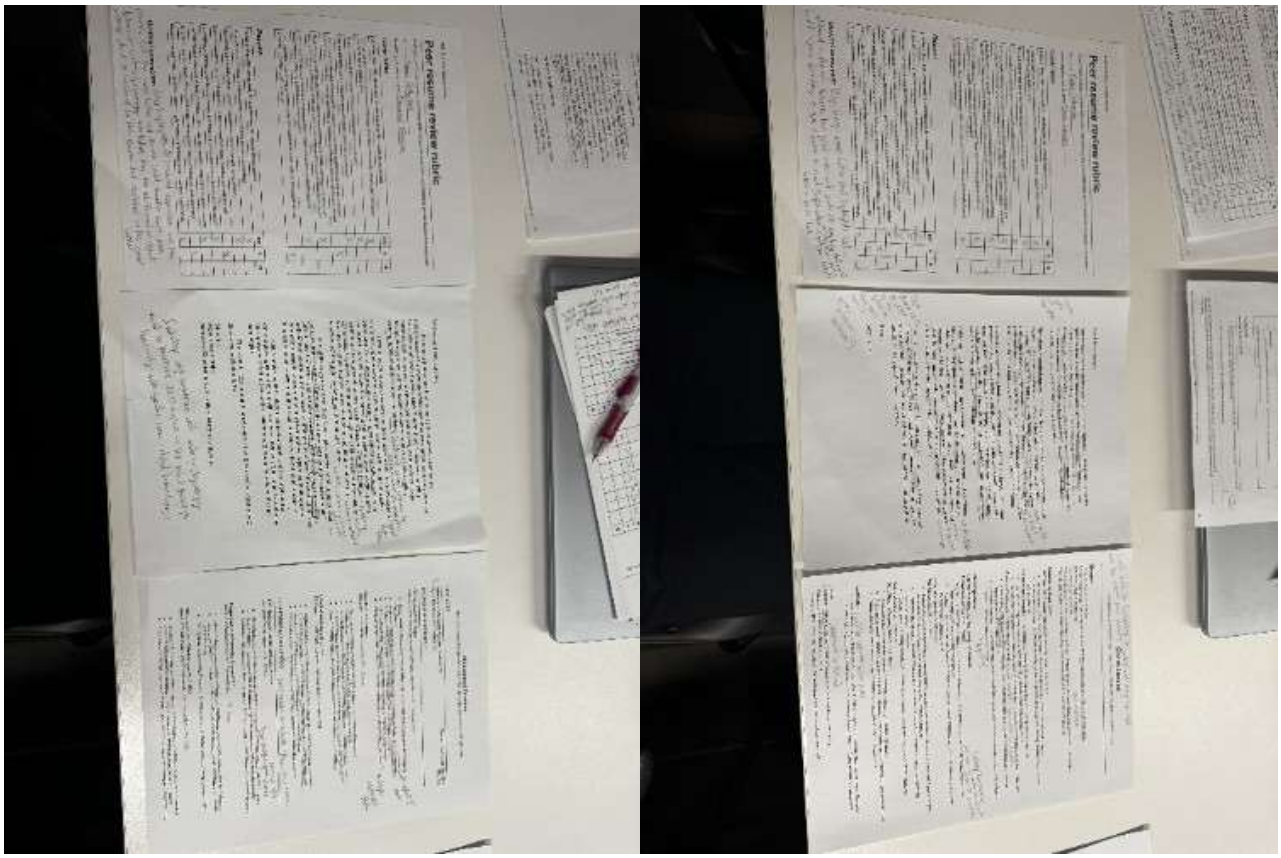
Date: 02/04/2026

Content by: Simon

Present: N/A

Goals: Review cover letters and resumes for two classmates

Content:



Images of the cover letter and resumes for Mohammed Ibrahim and Sienna Loosen

Conclusions/action items: This activity was useful for reviewing and being able to criticize other classmates application materials. The ability to review the materials of other classmates will help me understand what I can improve on my own cover letter and resume. I plan on using the feedback I received in class to create final versions of my cover letter and resume.

02/11/2026 Job Interviewing

SIMON FETHERSTON - Feb 11, 2026, 5:11 PM CST

Title: Job Interviewing Lecture

Date: 02/11/2026

Content by: Simon

Present: N/A

Goals: Practice interview skills

Content:

Presentation notes

- Use bullets
  - never have a single hanging bullet
- Consistent fonts
- Use a logical flow
  - designs should be in the same order in all places
- Only use content that you will talk about
- Keep audience interested
- Only hit highlights on design matrix
- Figure captions:
  - Figure X. what is it, key function/feature, citation if not your own
- CAD
  - Use labelled 3D view
  - Can use a detailed sketch with good labels and background removed
- Results
  - Graph data
- Storytelling through figures
  - Exploded views
  - Block diagram

Activity:

1. List your three chosen questions, and the questions picked by others in your group.

My Questions:

1. Tell me about a specific experience of yours that illustrates your ability to influence another person verbally. Feel free to use an example that involves changing an attitude, selling a group on an idea, or being persuasive about a goal that you had.

2. Some of the best business ideas come from an individual’s ability to challenge other people’s ways of thinking in a mature way. Tell me about a time when you were successful in challenging the ideas of others.

3. Describe a time when you had to commit to a plan of action in an emergency. Give me the details of the situation, make clear why it was an emergency and what was at stake; then tell me how long it took you to take action. What was the outcome?

Mariah:

1. Consider your most recent engineering job or academic engineering project: tell us one thing that you’ve learned recently from that job or experience.

2. Describe a time when you had to commit to a plan of action in an emergency. Give me the details of the situation, make clear why it was an emergency and what was at stake; then tell me how long it took you to take action. What was the outcome?

3. Six months from now we are all going to know each other very well. What will everyone here say you do really, really well? And what do you think everyone will know you could do better?

Mohammed:

1. Consider your most recent engineering job or academic engineering project: tell us one thing that you've learned recently from that job or experience.

2. Talk about a time in your life when you had to move to live in a different area: what were the big challenges about the move, what made you most uncomfortable, and what strategies did you develop to become more comfortable? How did you deal with the change?

3. Six months from now we are all going to know each other very well. What will everyone here say you do really, really well? And what do you think everyone will know you could do better?

2. Type your responses to your questions.

1. On my senior year soccer team, I was one of the captains. Midway through the season, some of the younger players on the team began to have attitude and discipline issues that were causing our quality of play to decrease and even lose some games. After practice, I called a meeting together with the younger players on the team. I talked with them about my friendships with the seniors on the team and our dedication toward winning a state championship. This conversation was able to motivate the younger players to not play for themselves, but to play for us seniors and commit to winning a state championship. This change in perspective flipped the season around and we were able to achieve our goal of winning a state championship.

2. At my summer research experience with the Medical College of Wisconsin, I was tasked with determining a way to cull adaptive optics visual acuity data in real time. After meeting with the research team, they were all set on the idea that I would just use previous data to create a simple solution. However, I challenged this idea by developing a method that focused on the statistical tests being used and developing parameters. My method was able to accurately cull data that the manual method incorrectly removed or missed.

3. As a lifeguard, I am committed to being prepared and responding to emergency situations. ON the hottest day in 2024, a patron at my pool suffered a severe heat induced seizure. I was the initial responder on the scene and committed to initiating and enacting the emergency action plan. I responded immediately to seeing signs of convulsions. After providing shade to the patron, keeping them alert, and monitoring their signs of consciousness, I was able to keep the patron stable until emergency medical services could arrive. This response prevented any severe conditions such as cardiac arrest and the patron was able to be released from the hospital that same day.

3. Describe one thing each of your peers did well during their answers, and one thing they can improve.

Mohammed did well at describing stories that specify skills applicable to engineering fields. I think one thing he could improve on is using stories and experiences that show their soft skills and interests. Mariah did well at speaking confidently with her answers which made them come across well. I think she could improve on focusing her stories using the STAR method (situation, task, action, and result).

4. After discussing your answers with your group, how could you improve your answers?

I could improve on my answers by emphasizing some of my technical skills as well. In the response regarding my research experiences, I could mention specific statistical analysis I conducted and what tools I used.

5. How might you improve your interview skills?

I would improve my interview skills by practicing more. I find myself getting lost in the question and may overexplain a prompt or not accurately answer the question. By practicing more either by myself or attending practice interviews, I could improve my confidence and ability to answer questions. I could also improve my interview skills by coming up with a few answers that could be applicable to various questions. This can help me respond to prompts that I may not expect or do not know how to answer right away.

Conclusions/action items: This activity was helpful at identifying weaknesses in my interviewing skills. I will make sure to continue practicing and use the feedback from this activity in future interviews.

02/18/2026 Presentation Peer Review

SIMON FETHERSTON - Feb 18, 2026, 4:55 PM CST

Title: Presentation Peer Review Lecture

Date: 02/18/2026

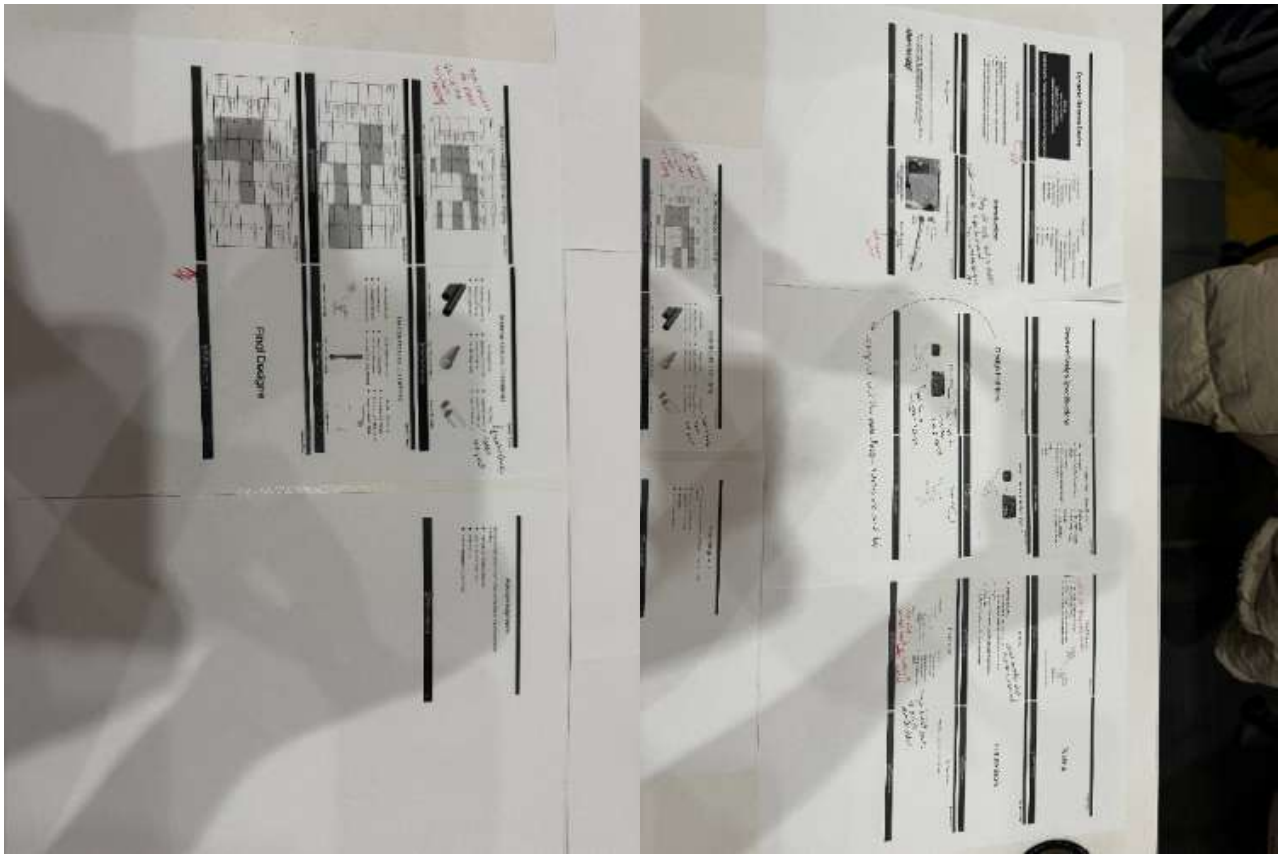
Content by: Simon

Present: N/A

Goals: Give and receive feedback on preliminary presentation slides

Content:

Make sure link to presentation and PDF are uploaded to team website



Conclusions/action items: This activity helped me to visualize how our presentation should look. By providing feedback on another presentation, I was able to find points of improvement for our own project. I also received feedback on our presentation that will be implemented before presenting.

2026/02/25 Diversity and Inclusion in Design

SIMON FETHERSTON - Feb 25, 2026, 2:09 PM CST

Title: Diversity and Inclusion in Design

Date: 02/25/2026

Content by: Simon

Present: N/A

Goals: Learn about how to apply diversity and inclusion in design

Content:

What does diversity mean in engineering design?

- Inclusion
- Being open to other ideas
  - Willing to look at ideas from a different point of view
  - Accepting ideas that you may not have thought of
  - Every idea is important
- Using problem-solving from multiple perspectives
- Taking into consideration cultural and religious beliefs
- Accessibility of designs
  - Price is not a limiting factor
- Testing with various groups
- Ethnicity
- Socioeconomic status

Universal Design

- Consider:
  - Age
  - Ethnicity
  - Location/environment - where will the design be used
  - Socioeconomic status
  - Size
  - Simplicity
  - Flexibility
  - Adaptability
  - Lack of need for specialized design

7 principles

1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

How does this relate to ethics?

- Honest about risks
- Testing broad demographic
- Good intent

Conclusions/action items: This lecture was useful for understanding diversity in design. It will be important to consider the 7 principles in our design. We will use these principles to help guide our further design process.

03/04/2026 Patents and Standards

SIMON FETHERSTON - Mar 04, 2026, 1:57 PM CST

Title: Patents, Standards, and Other Resources in BME

Date: 03/04/2026

Content by: Simon

Present: N/A

Goals: Learn about how to read and search for patents and standards

Content:

Full texts via database

- ASTM
- ASABE
- IEEE

Market and Industry Sources

- Find information on companies, industries, and consumer trends via business databases
    - Use these resources for margin analysis
- Data Axle Reference Solutions
- IBISWorld Industry Records
- ProQuest One Business

Evaluation

- independent claims
    - standalone
- dependent claims
    - must refer to a previous claim
    - must further limit the claim

Conclusions/action items: This lecture went through lens.org to look at patents. Patent research is important to know if the device could be patented or marketed if it is similar to an existing design. Researching existing patents will be important for the project. The team will continue to look at existing patents to determine categorization of the device as well as marketability.

03/06/2026 Tong Lecture

SIMON FETHERSTON - Mar 06, 2026, 1:28 PM CST

Title: Tong Lecture

Date: 03/06/2026

Content by: Simon

Present: N/A

Goals: Learn about Prof. Justin William and his work during the Tong lecture

Content:

From Imagination to Implantation: Turning Science Fiction into Brain Technologies

This lecture from Prof. Justin Williams covered the various companies he has developed and his trajectory in biomedical engineering.

Conclusions/action items: This lecture emphasized the importance of working with good people. Many of the companies Dr. Williams created were founded by the same people. Being able to find a group that can collaborate and work together is incredibly useful for product development. I also was interested by how many groups he was a part of and how each one was successful and unsuccessful in their own ways. Some of the companies were bought out and never developed, while others went public. This shows that the design and development process is not linear and there will be many challenges and changes along the way.

03/11/2026 Protocol Development

SIMON FETHERSTON - Apr 28, 2026, 6:24 PM CDT

Title: Protocol Development

Date: 03/11/2026

Content by: Simon

Present: N/A

Goals: Learn about protocol development

Content:

- Low fidelity prototyping is important
- Fittings
- Simple calculation
- Free body diagrams
- Mechanics of materials

Materials - detailed list = match materials expense table + more

- Name of the material
- Concentration, amount or starting dimensions
- Manufacturer and part number
- Purpose of the material
- List of equipment needed (manufacturer and model number)

Methods - step by step plan - list

- Mix - for how long and with what vigor
- Cut - with what tool and what size

Should be repeatable by unfamiliar reader

3D printing:

- materials
  - manufacturer and model of printer
  - filament material, diameter, and model number
- Methods used - details

Manufacturing

- Cannot manufacture everything you can 3D print
- Common methods
  - molding - blow, injection, thermoforming, extrusion, rotational
  - machining - mill, lathe, waterjet
  - joining - welding, soldering, screwing, riveting, adhesives

Fabrication Details

- Name of fabrication step/portion of prototype:
- Date to be completed:
- Team member(s) fabricating:
- Detailed sketch of portion of prototype being fabricated (Include dimensions)!:
- Detailed bulleted steps of fabrication:

Conclusions/action items: The notes were used to make testing and fabrication protocols. Each protocol was detailed and included the relevant information. Future protocols will follow this same format.

03/18/20206 Oral Presentation Skills

SIMON FETHERSTON - Mar 18, 2026, 1:41 PM CDT

Title: Oral Presentation Skills

Date: 03/18/2026

Content by: Simon

Present: N/A

Goals: Learn about how to improve elevator pitches

Content:

Elevator pitches:

- succinctly and effectively present ideas
- know your audience
- practice, practice, practice
- be authentic
- keep it simple
- adapt and iterate
- Structure:
    - attention grabber
    - introduction
    - value proposition
    - benefits
    - call to action
- Do's
    - eye contact
    - excitement
    - tailor pitch
- Don'ts
    - overwhelm with details
    - forget to listen and engage with the audience
    - sound rehearsed or robotic

Executive summary

- elevator pitch in a one page document
- roadmap that highlights the most important points and key takeaways
- saying more with less
- hit key points of selected award criteria

Conclusions/action items: This lecture helped me prepare for show and tell as well as the final presentation. I will use this information to prepare elevator pitches that will help me keep the audience engaged and interested in the project. I will make sure to alter these pitches based on the audience in front of me. None of the pitches I do will be the same so that I can effectively present to anyone.

03/25/2026 Engineering Ethics

SIMON FETHERSTON - Mar 26, 2026, 9:58 AM CDT

Title: Ethics in Engineering

Date: 03/25/2026

Content by: Simon

Present: N/A

Goals: Discuss ethics in engineering

Content:

Where do ethics come from

- family
- personal experience
- religion

Personal vs professional ethics

- Personal
  - implicit
  - varies from person to person
- Professional
  - explicit
  - code of ethics

Decision making process

- awareness
- stakeholders
- options
- analysis of plan

Components of our project:

One major component is the material choice. Using gelatin is a major ethical concern because it could limit the available market. Additionally, testing of the device is necessary to understand degradation and potential surgical complications. Understanding the mechanism of degradation is necessary to ensure there is not unknown inflammation. Also, testing placement of the design is necessary to ensure that the placement do not disrupt the effective use of the therapy. Our team will address these ethical dimensions by continuing to test different biomaterials, such as alginate, that will not limit the use and will continue to have the necessary design constraints.

Conclusions/action items: Engineering ethics is important to consider with any project. Considering various viewpoints and effects of the desire will ensure the safe and ethical use of the design. This activity will help the team to ensure the prototype follows the engineering code of ethics.

04/08/2026 Engineering Judgement Lecture

SIMON FETHERSTON - Apr 08, 2026, 1:58 PM CDT

Title: Engineering Judgement Lecture

Date: 04/08/2026

Content by: Simon

Present: N/A

Goals: Learn about engineering judgement

Content:

- How is engineering judgement learned
  - real-world problems
  - open ended problems
  - changing conditions
  - asking questions
  - handling uncertainty

Conclusions/action items: During this lecture we completed the engineering judgement activity. We reviewed the different aspects of engineering judgement. The sections were mostly clear and applicable. When I continue to make decisions, I will consider engineering judgment. This will help me make logical and well-informed decisions.

04/15/2026 Poster Making

SIMON FETHERSTON - Apr 28, 2026, 6:23 PM CDT

Title: Poster Making Lecture

Date: 04/15/2026

Content by: Simon

Present: N/A

Goals: Learn about how to improve poster making

Content:

Steps:

- read requirements
- include relevant and correct contact information
- descriptive title and subtitles
- have a storyline

Formatting:

- formatting captions: figure number, title, description, citation
- colors
- must be able to read from 3 ft away - font size 24-28

Context of use and workflow:

- Start with user and setting
  - show workflow
  - include used-device interaction
- Place in a larger system
- use color and grouping to organize and show what belongs together
- labels with minimal text

Conclusions/action items: These notes were used to help create the final poster. For this poster, it was important to focus on workflow. This allowed the design process to be understandable and tie in how the testing affected the design.

01/29/2026 Impact of Gastrointestinal Anastomotic Leaks

SIMON FETHERSTON - Jan 29, 2026, 9:59 PM CST

Title: Impact of gastrointestinal anastomotic leaks

Date: 01/29/2026

Content by: Simon Fetherston

Present: N/A

Goals: Learn about the impact of gastrointestinal anastomotic leaks on patient survival

Search term: "Gastrointestinal leaks AND demographic" in PubMed

Citation:

[1] E. Mor *et al.*, "The impact of gastrointestinal anastomotic leaks on survival of patients undergoing cytoreductive surgery and heated intraperitoneal chemotherapy," *The American Journal of Surgery*, vol. 223, no. 2, pp. 331–338, Feb. 2022, doi: 10.1016/j.amjsurg.2021.03.061.

Content:

- Cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS/HIPEC) are accepted surgical approaches for patients with peritoneal surface malignancies.
    - high morbidity rates of 22%-34%
    - mortality estimated at 3-8% regardless of primary tumor type
        - mostly related to GI leaks
    - 8-12% rate of GI leaks
        - 72% rate of reoperation following GI leak
- GI leaks
    - life-threatening complication
    - patients suffer from severe intra-abdominal infections, longer hospital stay, and reduced quality of life
    - Prevention, identification, and adequate management of GI leaks is challenging
- The study
    - Demographics: age, gender, body mass index, and co-morbid conditions
        - 536 patients - 191 met inclusion criteria
            - 34/191 or 17.8% of patients with post-operative GI leaks
            - median age of patients was 60 with a range of 21-87 years old
    - Patient oncological status
    - Perioperative and operative parameters
    - Post-operative outcomes
    - Found that the use of stapler reconstruction and anastomoses was associated with GI leaks

Conclusions/action items: This article is helpful to understanding the impact of GI leaks on surgical procedures and patient health. An 8-12% rate of GI leaks is a significant issue from the CRS/HIPEC surgical procedure. Since GI leaks can cause major health issues resulting in prolonged hospital visits and even death, it is clearly a problem that needs a solution. The reoperation rate and difficulty of endoVAC treatments shows that an improved method is necessary.

- Continue researching ethical considerations of endoVAC therapy

SIMON FETHERSTON - Jan 29, 2026, 9:35 PM CST

Download

Impact_of_GI_Leaks.pdf (459 kB)

01/28/2026 EndoVac Using Eso-Sponge

SIMON FETHERSTON - Jan 28, 2026, 4:30 PM CST

Title: Endoluminal vacuum therapy of esophageal perforations

Date: 01/28/2026

Content by: Simon

Present: N/A

Goals: Investigate the tools and procedures involved with endoluminal vacuum therapy through a case report study

Search Term: "Endoluminal vacuum therapy" in PubMed

Content:

- Weakness of esophago-gastric or esophago-jejunal anastomosis is a problem in esophageal surgery
    - leakage rates of 25% are the rule [3,4]
        - 3. Martin LW, Swisher SG, Hofstetter W et al (2005) Intrathoracic leaks following esophagectomy are no longer associated with increased mortality. Ann Surg 242(3):392–402. https://doi.org/10.1097/01.sla.0000179645.17384.12
        - 4. Sarela AI, Tolan DJ, Harris K, Dexter SP, Sue-Ling HM (2008) Anastomotic leakage after esophagectomy for cancer: a mortalityfree experience. J Am Coll Surg 206(3):516–523. https://doi.org/10.1016/j.jamcollsurg.2007.09.016
- Past methods in early re-operation, endoscopic clipping, or stent insertion have been unsuccessful or difficult

History of sponge usage

- Originally used a sponge for cutaneous wounds that was cut and sewn to a nasogastric tube
- Commercially available designs have been approved for upper GI Tracy [13]
    - Eso-Sponge
    - Similar to past designs but use different method of insertion
        - Change from piggyback technique to using a pusher and overtube to apply sponge system
            - Method uses a pusher to advance the sponge until it aligns with the tip of an applied overtube
            - Can be difficult or dangerous to insert due to relative stiffness and thickness of overtube
            - Sponge is pushed blindly and risks dislocation

Their method:

- Use the Eso-Sponge

Figure 1: Application of the sponge using the piggyback method. A. Air knot is tied. B. Knot is grabbed by forceps. C. Pull into working canal so the tips of the scope and sponge align. D. Scope and sponge are brought into patient via piggyback. E. Patients are sedated to overcome resistance in the upper esophageal sphincter. F. Forceps are opened and freed from the suture by a short wiggling motion.

Conclusions/action items: This article provided useful information about the EndoVAC procedure. The visuals were especially important to understand what is happening at each stage of the procedure. It is important to note the challenges associated with the procedure. The article mentioned the stiffness and thickness of an overtube as a challenge when applying the sponge. They also mentioned that there is some resistance when the sponge is being applied. Both of these challenges could be considered as potential design specifications.

- Research other procedure techniques
- Research the societal and economic impact of the procedure

BRIEF REPORT

Placing vacuum sponges in esophageal anastomotic leaks — how we do it

Florian Hantschel[1,2] · Götz Mollenhauer[3] · Björn Siemsen[2] · Christoph Paasch[1,3] · René Mantke[1] · Stefan Litz[1]

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Abstract

Purpose Endoluminal vacuum sponge therapy has dramatically improved the treatment of anastomotic leaks in esophageal surgery. However, the blind insertion of vacuum sponge kits like Eso-Sponge® via an overtube and a pusher can be technically difficult.

Methods We therefore insert our sponges under direct visual control by a nonstandard "piggyback" technique that was initially developed for the self-made sponge systems preceding these commercially available kits.

Results Using this technique, we inserted or changed 56 Eso-Sponges® in seven patients between 2013 and 2023. Apart from one secondary sponge dislocation, no intra-or extra-luminal complications were encountered. One patient died due to unrelated reasons. In all others, the defects healed and they were dismissed from the hospital. Long-term follow-up showed three strictures that were successfully treated by dilatation.

Conclusion We conclude that sponge placement via piggyback technique is a fast, safe, and successful alternative to the standard method of insertion.

Keywords Esophagus · Esophagogastric anastomosis · Anastomotic leak · Vacuum therapy · Eso-Sponge®

Introduction

A frequent problem in esophageal surgery is the weakness of the esophagogastric or esophagojejunal anastomosis [1, 2]. Unlike in other anastomoses in the GI tract, leakage rates of up to 25% are the rule rather than the exception here [3, 4]. Moreover, for a long time all methods of treating these leaks, like early re-operation, endoscopic clipping, or stent insertion, were rather unsuccessful and frustrating [5]. This situation changed dramatically with the introduction of endoluminal vacuum therapy in the upper GI tract in 2007 [6–8].

And even if there are no large head-to-head studies yet, the superiority of this principle has since been proven [9, 10].

In the first years after the introduction of vacuum therapy in the upper GI tract, endoscopists used self-made systems [6]. These usually consisted of a sponge intended for cutaneous wounds that were cut to size and sewn to a nasogastric tube [11, 12]. Since 2014, these kits are more superseded by commercially available endoluminal vacuum sponge systems that were designed and approved for the use in the upper GI tract (Eso-Sponge®, B. Braun, Germany) [13]. In these systems, the tube and sponge come in one piece, but they are mainly of the same functions as the old ones. The main difference is the method of insertion. While the old systems were introduced via the piggyback technique (see below), the new ones consist of the sponge system itself, an overtube, and a pusher. In brief, the overtube is put over the gastroscope and placed inside the cavity, the scope is then removed, and the sponge is advanced by a special pusher that has a longitudinal lumen for the vacuum line. Once a mark is reached that indicates that the sponge and the tip of the overtube align, the pusher will be fixated and the overtube slowly

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Published online: 07 March 2024

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Placing_Vacuum_Sponges.pdf (837 kB)

02/05/2026 Suprasorb CNP Drainage Film

SIMON FETHERSTON - Feb 05, 2026, 8:07 PM CST

Title: Endoscopic negative pressure therapy for upper gastrointestinal leaks: description of a fashioned device allowing simultaneous enteral feeding

Date: 02/05/2026

Content by: Simon

Present: N/A

Goals: Research commercially available products that are used to treat gastrointestinal leaks

Citation:

[1] R. Archid, F. Bazerbachi, M. C. Thomas, A. Königsrainer, and D. Wichmann, “Endoscopic negative pressure therapy for upper gastrointestinal leaks: description of a fashioned device allowing simultaneous enteral feeding,” VideoGIE, vol. 6, no. 2, pp. 58–61, Dec. 2020, doi: 10.1016/j.vgie.2020.10.009.

Content:

This method uses an open-pore film drainage device to treat the upper GI tract

- Suprasorb CNP Drainage Film
  - perforated film that allows drainage and promotes tissue granulation
  - Film is sutured around a 16F gastric decompression tube
    - Off-label use for both the drainage film and the decompression tube
  - A suture is used to secure the film to the gastric decompression tube
  - Passed to the treatment location using the Seldinger method
- Method using OFD with a diameter of 4-8 mm made it easier to establish negative pressure for small defects
  - reduced adhesiveness
  - easy removal
  - decreased damage to surrounding tissue

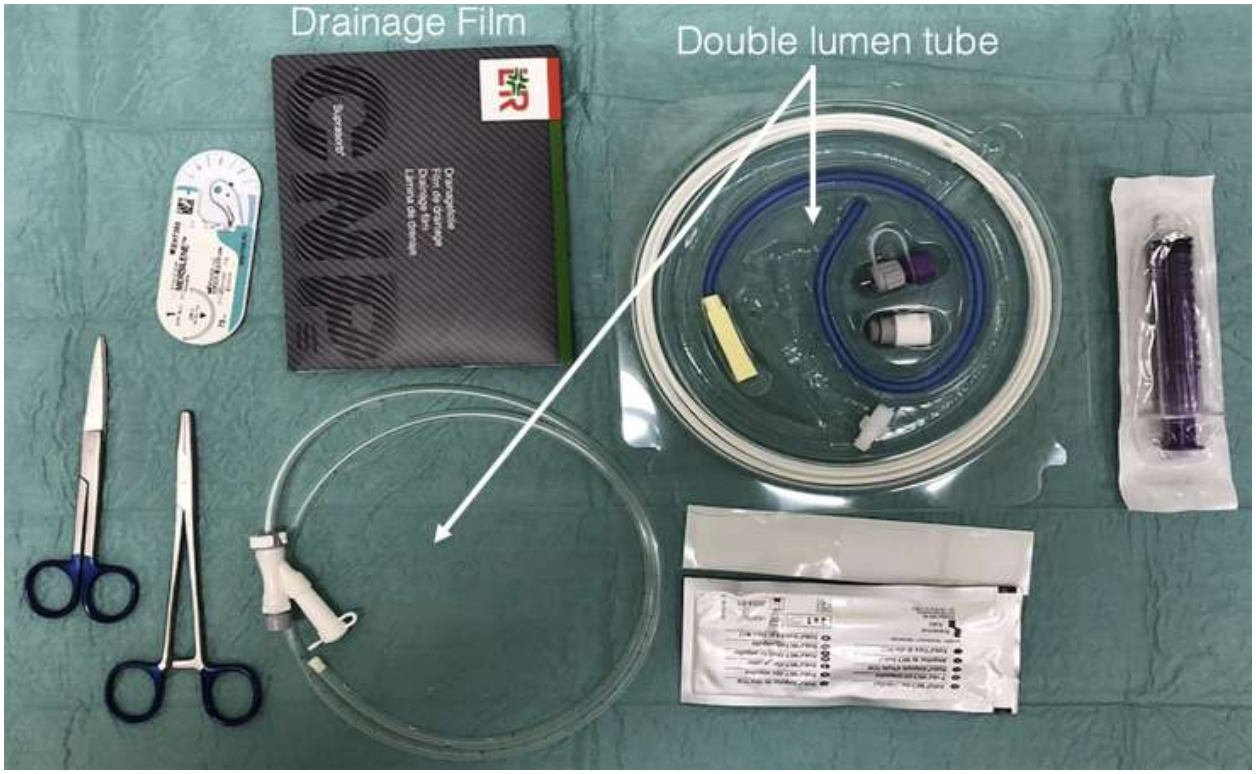
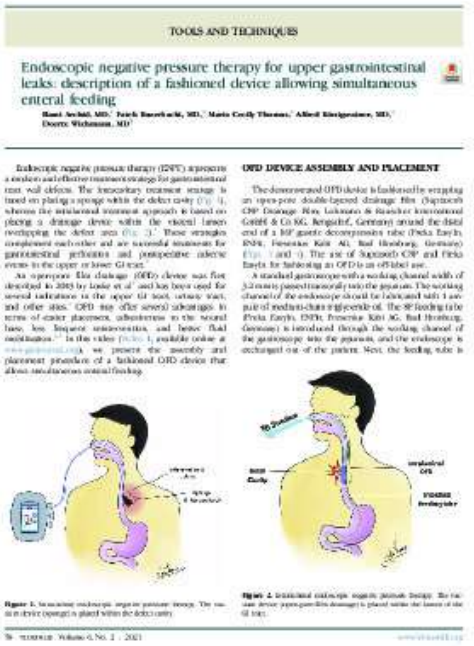


Figure 1: Equipment needed to assemble the open-pore film drainage device: dual-lumen tube for intestinal feeding (8F) and gastric decompression (16F), drainage film, and suturing material.

Conclusions/action items: This is a different method of treatment as opposed to the past research papers and case studies. The use of a feeding tube as a guide is an interesting approach. This is different from the use of an overtube which could be larger and difficult to place. It could be useful to consider a design that focuses on guiding a sponge/film into place instead of forcing it into place.

- Generate preliminary design ideas

SIMON FETHERSTON - Feb 05, 2026, 8:08 PM CST



TOOLS AND TECHNIQUES

Endoscopic negative pressure therapy for upper gastrointestinal leaks: description of a fashioned device allowing simultaneous enteral feeding

OVD DEVICE ASSEMBLY AND PLACEMENT

Download

Suprasorb_CNP_Drainage_Film.pdf (1.42 MB)

01/27/2026 - EndoVac Observational Study

SIMON FETHERSTON - Jan 28, 2026, 1:01 PM CST

Title: Endoluminal vacuum therapy for upper gastrointestinal leaks: safe, effective and minimally invasive – insights from a retrospective observational study

Date: 01/27/2026

Content by: Simon

Present: N/A

Goals: Understand the use and effectiveness as endoluminal vacuum therapy for upper gastrointestinal leaks

Search Term: "Endoluminal vacuum therapy" entered into PubMed

Citation:

[1] M. Sánchez-Rodríguez *et al.*, “Endoluminal vacuum therapy for upper gastrointestinal leaks: safe, effective and minimally invasive - insights from a retrospective observational study,” *Surg Endosc*, Nov. 2025, doi: 10.1007/s00464-025-12381-1.

Content:

Background information

- Upper gastrointestinal leaks have high morbidity and mortality - should conduct background research on causes and symptoms of UGI leaks
- GI leak - pathological communication between intraluminal space and the extraluminal compartment, with a defect in the integrity of the GI wall
  - can result from endoscopic procedures or postoperative complications
  - 8-26% after esophagectomy, 3–12% after total gastrectomy, 1-2% following sleeve gastrectomy, and 2–8% after gastric bypass for bariatric surgery
- Endoluminal vacuum therapy offers a minimally invasive alternative to managing leaks during surgical procedures
- EVT is non-standardized and does not have clear and definitive data about its effectiveness
  - leak etiology, optimal placement, effectiveness, healing duration, and role of complementary therapies have heterogeneous data

The study - an observational, retrospective, single-center study from a cohort of patients with UGI leaks treated with EVT at Hospital General Universitario Gregario Maranon

- Primary endpoint of study was leak resolution
- Secondary endpoint included morbidity and mortality, number of sponge exchanges, duration of therapy, and need for additional interventions
- EVT performed using EsoSponge device
  - Placement of polyurethane sponge via an overtube and pusher under endoscopic guidance
  - Cavity and defect margins are cleaned endoscopically, sponge is set, and an oro-nasal exchange is was performed to connect drainage tube to a continuous negative pressure system

Results

- 30 patients treated with EVT
- 16.6% of patients had complications
  - sponge fragmentations and strictures
- 90% success rate
  - 55% required an additional endoscopic treatment

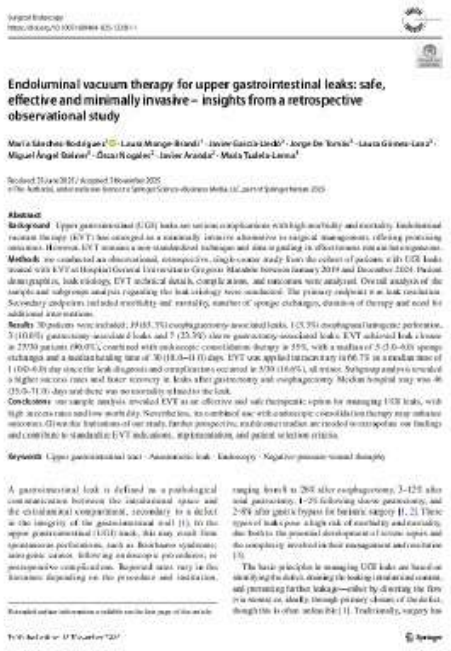
Conclusions/action items:

The results of this study show that EVT could become a useful surgery management strategy. However, the need of second-intention healing and attachment to the negative pressure device can prolong hospital stays. Also, the use of endoscopic consolidation therapy with differing materials has

not been extensively researched. Much more research is needed to understand how EVT therapy works and what its limitations are. Understanding the mechanisms of GI leaks could also help guide material choices and aspects of the design.

- Continue preliminary research

SIMON FETHERSTON - Jan 27, 2026, 4:34 PM CST



Endoluminal vacuum therapy for upper gastrointestinal leaks: safe, effective and minimally invasive – insights from a retrospective observational study

Download

EndoVac_Therapy_Observational_Study.pdf (1.36 MB)

01/28/2026 How to Use Endoluminal Vacuum Therapy Video

SIMON FETHERSTON - Jan 28, 2026, 1:04 PM CST

Title: How to Use Endoluminal Vacuum Therapy Video

Date: 01/28/2026

Content by: Simon

Present: N/A

Goals: Watch the YouTube video to understand how endoluminal vacuum therapy works and is conducted

Link: https://www.youtube.com/watch?v=4bt0f9-79qs&rco=1

Search Term: Video was provided by client (no search was conducted)

Citation:

[1] SAGES - Minimally Invasive Surgery Videos, *V113 HOW TO USE ENDOLUMINAL VACUUM THERAPY*, (Sep. 30, 2015). Accessed: Jan. 28, 2026. [Online Video]. Available: https://www.youtube.com/watch?v=4bt0f9-79qs

Content:

- treat rectal anastomotic leaks and later upper intestinal leaks
- benefits of vacuum assisted closure
    - polyurethane foam with a nasogastric tube
    - uniform applied negative pressure
        - continuous drainage
    - complete closure
        - granulation tissue formation
        - wound contraction

How to use Endoluminal Vacuum Therapy

- Tools
    - NG tube
    - small piece of granufoam
    - suture
- Steps
    - Perform a through endoscopic examination
        - assess size of defect and adjacent activity
        - identify structures within cavity
        - identify problematic drainage areas
        - check for the presence of necrosis
    - Irrigate and debride
    - Place transnasal NG tube
    - Attach foam to NG tube
    - Place foam
        - overtube
        - piggyback
        - flexed-tube
        - rendezvous
            - cannot be used with perforated or fluted drains
- Failure to appropriately place foam can lead to inadequate drainage and sepsis
- Placement of same size foam can prevent wound contraction and can delay closure time
- When to change foam
    - early: every 3-4 days
    - later: 4-7 days

Conclusions/action items: This video was beneficial to understanding how endoluminal vacuum therapy is performed. I can now understand how complications can occur and what makes it an advanced procedure. Now that I know how the procedure is performed, I can brainstorm questions about what are the preferred methods of delivery and what are the specific challenges with those methods. These questions will be discussed with our client during our client meeting

- Brainstorm questions
- Follow this link https://pmc.ncbi.nlm.nih.gov/articles/PMC10914858/#:~:text=Abstract,Results to read about one of the sponge delivery techniques
    - could provide some useful information for design specifications
    - Citation:

[1] F. Hentschel, G. Mollenhauer, B. Siemssen, C. Paasch, R. Mantke, and S. Lüth, “Placing vacuum sponges in esophageal anastomotic leaks — how we do it,” *Langenbecks Arch Surg*, vol. 409, no. 1, p. 86, 2024, doi: 10.1007/s00423-024-03272-5.

01/29/2026 Negative Pressure Case Report

SIMON FETHERSTON - Jan 29, 2026, 10:43 PM CST

Title: Negative pressure, positive outcomes: A case report of Endovac therapy in complex sleeve gastrectomy leaks

Date: 01/29/2026

Content by: Simon

Present: N/A

Goals: Review a case report on Endovac therapy to identify potential design specifications and complications of current methods

Search term: "Endovac" in Scopus

Citation:

[1] M. Agosta, M. Sofia, C. Mazzone, L. P. Greco, G. Faletra, and S. Latteri, “Negative pressure, positive outcomes: A case report of Endovac therapy in complex sleeve gastrectomy leaks,” *Int. J. Surg. Case Rep.*, vol. 132, 2025, doi: 10.1016/j.ijscr.2025.111453.

Content:

- Laparoscopic Sleeve Gastrectomy (LSG) is an effective bariatric procedure for obesity treatment
  - 1-3% GI leak incidence
    - severe morbidity, prolonged hospitalization, significant healthcare costs, increased risk of mortality
  - traditional post-op management strategies involve conservative treatment, endoscopic stenting, or surgical intervention
    - variable success rates
- Case report
  - 29 year old male with BMI of 35.4 kg/m^2
  - fistulous tract of 13-14 mm in diameter
  - Initial management with self-expanding metal stent displayed displacement and an increase in size of perigastric collection
  - 20 days after LSG, EVT was performed using Eso-Sponge System
    - Serial replacements of Eso-Sponge every four days
    - patient exhibited significant clinical improvement
    - cavity reduced to 2 cm
    - patient discharged 40 days after initial LSG

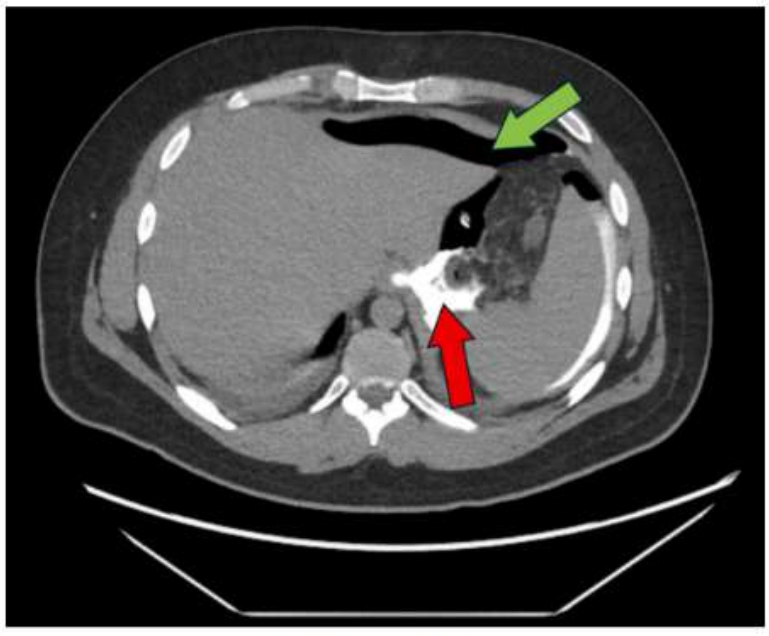


Fig. 1. *Abdominal CT scan showing gastric fistula with oral contrast extravasation (red arrow) into the perisplenic and perihepatic spaces, associated with free int air (green arrow).* (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Review of endoVAC

- significant improvement in leak management
    - enhances tissue granulation, reduces edema, controls local infection, and fascilitate closure of gastrointestinal fistulas and leaks
    - Challenges:
        - need multiple endoscopic interventions
        - patient discomfort
        - potential sponge dislodgement
        - procedure-related complications
    - risks can be mitigated using meticulous technique and rigorous multidisciplinary care protocols
        - incremental pressure adjustments reflected guidelines for optimizing wound healing and minimizing complications
    - research needed on standardizing EVT protocols, defining optimal negative pressure settings, and evaluating long-term outcomes

Conclusions/action items: This clinical study is useful at understanding the complications related to using endoVAC therapy. These complications can help define design specifications. The most feasible criteria could involve patient comfort and ease of use. Creating a more ergonomic endoVAC delivery system could decrease discomfort and allow for smoother procedures. Effects of these criteria could be decreased interventions or decreased complications as a result of the procedure.

- Brainstorm design criteria in the PDS

SIMON FETHERSTON - Feb 04, 2026, 2:52 PM CST


International Journal of Surgery Case Reports

Case report

Negative pressure, positive outcomes: A case report of Endovac therapy in complex sleeve gastrectomy leaks

Marcello Agnes, Maria Sofia, Chiara Mazzone, Luigi Piero Greco, Gloria Taliento, Saverio Latteri

Download

Negative_Pressure_Positive_Outcomes.pdf (1.31 MB)

1/30/2026 Impact of EndoVAC in Cancer Management

SIMON FETHERSTON - Jan 30, 2026, 11:22 AM CST

Title: The Impact of EndoVAC in Addressing Post-Esophagectomy Anastomotic Leak in Esophageal Cancer Management

Date: 01/30/2026

Content by: Simon

Present: N/A

Goals: Review the impact of the endoVAC procedure and the ethical, economic, and environmental impacts

Search term: "EndoVAC impact" in Scopus

Citation:

[1] S. P. Papadakos *et al.*, "The Impact of EndoVAC in Addressing Post-Esophagectomy Anastomotic Leak in Esophageal Cancer Management," *JCM*, vol. 13, no. 23, p. 7113, Nov. 2024, doi: 10.3390/jcm13237113.

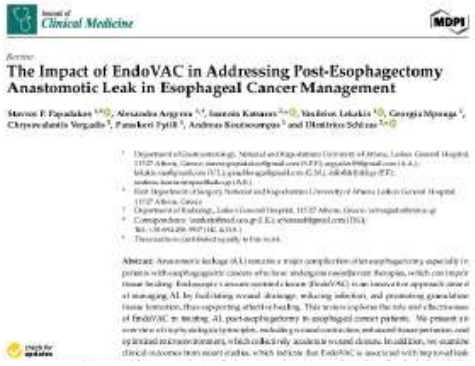
Content:

- Anastomotic leakage remains a major complication after esophagectomy, especially patients with esophagogastric cancers
  - most severe complication after esophagectomy
  - studies have shown a 10.6% incidence of leakage after esophagectomies
- Benefits of EndoVAC
  - macrodeformation - reduction of wound surface area
  - microdeformation - creation of corrugated wound surface through applied negative pressure
  - fluid draining promotes tissue perfusion
  - shorter hospital stay
    - conserves resources
- Results and Risks of EndoVAC
  - underutilized with availability at 64% of centers performing esophagectomies
  - can result in adverse effects
    - efficacy of EVT may imprve as providers gain more experience

Conclusions/action items: This article reviews the use of the EndoVAC procedure for leaks as a result of complications with esophagectomy surgeries. The article mentioned multiple times about the underutilization of EndoVAC as a treatment method. The treatment has not been significantly adopted due to its difficult procedure and resource intensive care. This can help develop design constraints to use less materials and create an accessible design. These specifications could allow for the benefits of EndoVAC to have a further reach and become accessible to more surgeons.

- Develop design specifications for PDS

SIMON FETHERSTON - Jan 30, 2026, 11:10 AM CST



Journal of Clinical Medicine

MDPI

Review

The Impact of EndoVAC in Addressing Post-Esophagectomy Anastomotic Leak in Esophageal Cancer Management

Download

EndoVAC_in_Cancer_Management.pdf (544 kB)

02/03/2026 ISO 10993-1

SIMON FETHERSTON - Feb 03, 2026, 1:37 PM CST

Title: ISO 10993-1 Biological evaluation of medical devices

Date: 02/03/2026

Content by: Simon

Present: N/A

Goals: Research medical device standards to include in PDS

Citation:

[1] "ISO 10993-1:2025," ISO. Accessed: Feb. 03, 2026. [Online]. Available: https://www.iso.org/standard/10993-1

Content:

Biological evaluation of medical devices — Part 1: Requirements and general principles for the evaluation of biological safety within a risk management process

- applies to biological evaluation of medical devices with direct or indirect contact with
  - patient's body during use or misuse
  - the body of other who are not patients
- consider biological risks associated with
  - constituents of a medical device
  - tissue-device interactions
- 6.6.6.4 Medical devices in contact with intact mucosal membrane
  - essential section due to devices contact with mucus membrane of GI tract
  - Looks at:
    - cytotoxicity
    - sensitization
    - irritation
    - systemic toxicity
    - local effects after tissue contact
    - genotoxicity
    - carcinogenicity
    - haemocompatibility
- 6.4.4.5 Medical devices in contact with either breached or compromised surfaces or internal tissues other than circulating blood

Conclusions/action items: This is an essential standard to use when designing the endoVAC device. The design must be in compliance with the ISO 10993 standards to ensure biocompatibility and biological safety. This standard will be added to the product design specifications as the materials and design must be biocompatible with the GI tract.

- Create product design specifications

SIMON FETHERSTON - Feb 03, 2026, 1:27 PM CST


Part 1:
Requirements and general principles for the evaluation of biological safety within a risk management process

Download

ISO_10993-1_2025.pdf (2.41 MB)

02/03/2026 ISO 8600-1

SIMON FETHERSTON - Feb 03, 2026, 1:51 PM CST

Title: Endoscopes -- Medical endoscopes and endotherapy devices -- Part 1 General requirements

Date: 02/03/2026

Content by: Simon

Present: N/A

Goals: Research standards that apply to the design

Citation:

[1] "ISO 8600-1:2025," ISO. Accessed: Feb. 03, 2026. [Online]. Available: https://www.iso.org/standard/84216.html

Content:

This standard giver definitions of terms and requirements for endoscopes and endotherapy devices.

- ISO 8600-4, Endoscopes -- Medical endoscopes and endotherapy devices -- Part 4: Determination of maximum width of insertion portion
  - Measure the width of endoscopic device to ensure compatibility with human anatomy and other devices
- ISO 14971, Medical devices -- Application of risk management to medical devices
  - risk management to consider the probability of misconnection of medical devices intended for connection to endoscopes or endotherapy devices to non-endoscopic patient connection
- Requires an instruction manual
- Minimum instrument channel width must be measured with instruments that have a resolution better than 0.01 mm

Conclusions/action items: This is another necessary standard because the medical device will be used in conjunction with or attached to an endoscope. Therefore, it is an endotherapuetic device and must follow the ISO standard. It will be important to follow the standards regarding the dimensions and measurements of the device to ensure it is compatible with a human GI tract. This standard will be used in the product design specifications.

- Create PDS

SIMON FETHERSTON - Feb 03, 2026, 1:39 PM CST

Download

ISO_8600-1_2025.pdf (1.31 MB)

02/05/2026 Product Classification

SIMON FETHERSTON - Feb 05, 2026, 8:27 PM CST

Title: Product Classification

Date: 02/05/2026

Content by: Simon

Present: N/A

Goals: Determine what class medical device the proposed device would be

Citation:

[1] "Product Classification." Accessed: Feb. 03, 2026. [Online]. Available: https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpcd/classification.cfm?id=FGS

Content:

- Carrier, sponge, and endoscopic device are considered Class II medical devices
  - moderate-risk
  - most are subject to 501(k) premarket approval
- Regulation description: endoscope and accessories
- Product code: FGS
- Premarket Review: Renal, Gastrointestinal, Obesity and Transplant Devices (DHT3A)
- 501(k) exempt
- Regulation number: 866.1500
- Not considered an implanted device
- Class II (special controls) devices are subject to certain limitations
  - some are exempt from premarket notification

Depending on the materials used, the device may be exempt from premarket approval.

Conclusions/action items: The EndoVAC materials are considered class II medical devices. These devices typically require premarket approval, however, endoscopes and accessories are exempt from this. The design choice will dictate if this holds true or not. If a feeding tube was used, it may be subject to different regulations. Also, the use of negative pressure may require premarket approval even if the sponge system does not.

- update PDS

SIMON FETHERSTON - Feb 05, 2026, 8:29 PM CST

Download

Product_Classification.pdf (305 kB)

02/13/2026 EsoCap PVA

SIMON FETHERSTON - Feb 13, 2026, 12:37 PM CST

Title: The EsoCap-system – An innovative platform to drug targeting in the esophagus

Date: 02/13/2026

Content by: Simon

Present: N/A

Goals: Learn about potential materials that could be used to encapsulate a sponge

Citation:

[1] J. Krause et al., "The EsoCap-system – An innovative platform to drug targeting in the esophagus," Journal of Controlled Release, vol. 327, pp. 1–7, Nov. 2020, doi: 10.1016/j.jconrel.2020.08.011.

Content:

Goal was to develop a drug delivery system that could deliver medication to a patient with Eosinophilic Esophagitis (EoE)

- Materials
  - Polyvinyl alcohol type 18-88 (PVA)
  - Glycerol - plasticizer
  - Demineralized water used as a solvent
- Film preparation
  - Solvents were mixed in a laboratory glass bottle and heated up to 90 C in a water bath under constant stirring, for two hours
  - Stirred in fluorescein sodium as a model drug for an additional 60 minutes at 90 C
  - Mass was stirred overnight until col

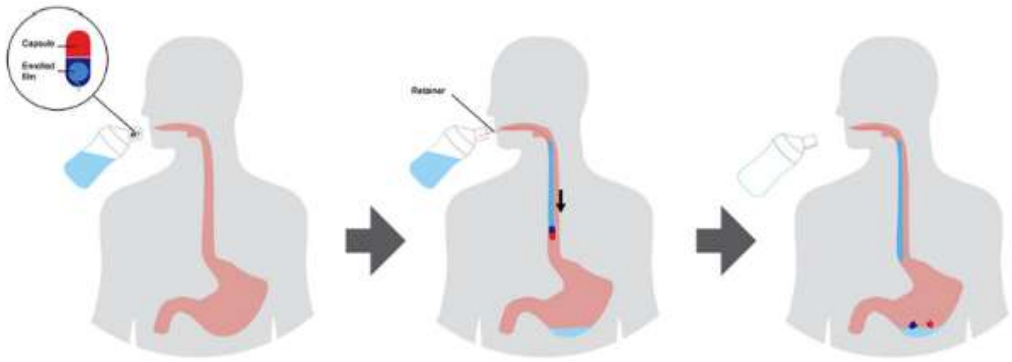


Fig. 3. Diagram of EsoCap application.

- All 12 subjects that used the EsoCap were able to successfully use it three days in a row
- Polymer film was visible for more than 15 min in 69% of all administrations
  - no observed negative side effects
- Results fit well with Cytosponge cell collection device

Conclusions/action items: this article was interesting to look at the materials used to make biocompatible films. The PVA film seemed to only last around 15 minutes within the esophagus. This type of film could potentially be able to encapsulate the sponge and allow easier placement for GI leaks.

- Continue looking at PVA biocompatibility
- Research other potential materials

SIMON FETHERSTON - Feb 13, 2026, 12:39 PM CST

Journal of Controlled Release

The EsoCap-system – An innovative platform to drug targeting in the esophagus

Julius Krause[a], Christoph Rosenbaum[a], Michael Grimm[a], Adrian Rump[a], Rebecca Keller[a], Norbert Hosten[b], Werner Weitschies[a,*]

ARTICLE INFO

ABSTRACT

1. Introduction

Download

EsoCap.pdf (1.38 MB)

02/13/2026 Chitosan

SIMON FETHERSTON - Feb 13, 2026, 12:55 PM CST

Title: Chitosan Based Biodegradable Composite for Antibacterial Food Packaging Application

Date: 02/13/2026

Content by: Simon

Present: N/A

Goals: Research potential materials that could encapsulate a sponge

Content:

Chitosan shows potential applications in food, agriculture, and medicine

- antimicrobial
  - antimicrobial activity is unknown but several mechanisms have been hypothesized
- antibacterial
  - positively charges amine groups
- non-toxic
- biodegradable
- made from a renewable source

Polysaccharides have been blended with chitosan to develop functional films

- starch - low cost, biodegradability
- chitosan-cellulose nanocrystals - enhanced oxygen barrier, increased tensile strength and Young's modulus
  - Costa, S.M.; Ferreira, D.P.; Teixeira, P.; Ballesteros, L.F.; Teixeira, J.A.; Fangueiro, R. Active natural-based films for food packaging
    applications: The combined effect of chitosan and nanocellulose. Int. J. Biol. Macromol. 2021, 177, 241–251. [CrossRef]

Table 1. Starch incorporated chitosan film with different additives.

Composite	Functional Properties		Physical Properties		References
	Antimicrobial Capacity	Antioxidant Activity	Thickness	Mechanical	
Chitosan/corn starch/glycerol	—	—	—	Tensile strength increased up to 2.24 times compared to pure chitosan	[58]
Chitosan/cassava starch/gallic acid/glycerol	Delayed microbial growth for two weeks	No significant changes compared to Trolox equivalent performance	—	Tensile strength increased from 0.51 to 0.83 MPa with the chitosan content	[65]
Chitosan/starch/sodium tripolyphosphate	—	—	20–100 nm diameter	—	[63]
Chitosan/sugar palm starch/extra virgin olive oil (EVOO)	Inhibitory activity against *E. coli* and *S.aureus*	Increased significantly on the addition of EVOO up to 2.0%	Varied based on EVOO content	Tensile strength increased up to 2561 MPa with the addition of 2% EVOO	[60]
Chitosan nanoparticle/tapioca starch/glycerol/sodium tripolyphosphate	Growth inhibition of *B. cereus*, *S. aureus*, *E. coli*	—	—	—	[64]

Table 1. Different composites and associated functional and physical properties

Conclusions/action items: This review was helpful at understanding the potential uses of chitosan. Many of the functional and physical properties of the chitosan composites would be desired in a film capable of delivering a sponge in the esophagus. The references in the paper will offer further insight into how the composites are made and what their potential uses could be.

- Read references that were included in the paper

SIMON FETHERSTON - Feb 13, 2026, 12:39 PM CST

polymers

Review

Chitosan Based Biodegradable Composite for Antibacterial Food Packaging Application

Download

Chitosan.pdf (2.94 MB)

03/04/2026 Pullulan

SIMON FETHERSTON - Mar 04, 2026, 10:45 AM CST

Title: Effect of Pullulan concentration in fast dissolving films formulation and exploration of film properties

Date: 03/04/2026

Content by: Simon

Present: N/A

Goals: Explore the feasibility of pullulan as a surrounding material

Citation:

[1] "(PDF) Effect of Pullulan concentration in fast dissolving films formulation and exploration of film properties." Accessed: Mar. 04, 2026. [Online]. Available: https://www.researchgate.net/publication/301728014_Effect_of_Pullulan_concentration_in_fast_dissolving_films_formulation_and_exploration_of_film_properties

Content:

- Study examines the dissolution and disintegration time of pullulan mixed with different plasticizers
- films were made from pullulan, pullulan + PEG, and pullulan + silver nitrate
- Each solution generate clear, shiny, and transparent films

Table 1. Properties of films made using pullulan solutions

Pullulan concentration	Thickness 2cm x 3 cm size, mm			*In-vitro* Disintegration time, sec	*In-vitro* Dissolution time, sec
1%	0.05	0.05	0.05	3	8
2%	0.25	0.25	0.25	5	24
3%	0.5	0.25	0.5	10	29
4%	0.7	0.6	0.7	13	34
5%	0.9	0.9	0.6	15	37

Table 2. Properties of films made using pullulan + PEG-400 solutions

Pullulan +PEG-400 (Plasticizer) concentration, w/v	Thickness 2cm X3 cm size, mm			*In-vitro* Disintegration time, sec	*In-vitro* Dissolution time, sec
5% + 1.5%	0.02	0.03	0.02	15	49
5% + 2%	0.03	0.02	0.02	22	54
5% + 2.5%	0.04	0.04	0.05	28	63
5% + 3%	0.07	0.07	0.06	36	71
5% + 3.5%	0.08	0.08	0.09	42	79
5% + 4%	0.09	0.09	0.09	51	86
5% + 4.5%	0.12	0.11	0.11	56	91
5% + 5%	0.15	0.14	0.14	62	97

Table 3. Properties of films made using pullulan + PEG-600 solutions

Pullulan +PEG-600 (Plasticizer) concentration, w/v	Thickness 2cm X3 cm size, mm			*In-vitro* Disintegration time, sec	*In-vitro* Dissolution time, sec
5% + 1.5%	0.2	0.2	0.2	20	88
5% + 2%	0.4	0.4	0.4	27	108
5% + 2.5%	0.6	0.5	0.6	46	121
5% + 3%	0.8	0.6	0.8	59	144
5% + 3.5%	0.9	1	0.9	62	153
5% + 4%	1.3	1.2	1.3	69	162

Table 4. Properties of films made using pullulan + silver nitrate solutions

Pullulan + silver nitrate concentration, w/v + mM	Thickness 2cm X3 cm size, mm			*In-vitro* Disintegration time, sec	*In-vitro* Dissolution time, sec
5% + 1	0.05	0.05	0.05	7	34
5% + 2	0.05	0.05	0.08	10	55
5% + 3	0.08	0.05	0.08	14	74
5% + 4	0.1	0.08	0.1	22	87
5% + 5	0.08	0.12	0.12	26	92
5% + 6	0.13	0.13	0.09	32	106
5% + 7	0.15	0.12	0.15	34	115
5% + 8	0.16	0.16	0.16	36	120
5% + 9	0.18	0.15	0.18	43	149
5% + 10	0.16	0.19	0.19	48	152

The PEG solutions had the largest in-vitro disintegration and dissolution times.

- These films were not recommended for fast dissolving oral films

Conclusions/action items: This paper was useful at looking at the potential of pullulan films to be used as the sponge coating. The mixtures of pullulan and PEG have potential due to the longer disintegration times. However, these times are less than a minute. A different concentration, or different materials, would be needed to achieve a 30 minute dissolution time. Using pullulan as an initial film and a vacuum seal and then using another material to cover it could prevent fast disintegration times. However, considering the mechanical strength is important as the sponge may cause the pullulan film to break due to low mechanical strength.

- Continue researching materials

SIMON FETHERSTON - Mar 04, 2026, 10:54 AM CST

Effect of Pullulan concentration in fast dissolving films formulation and exploration of film properties

Download

Effect_of_Pullulan_concentration_in_fast_dissolving_films_formulation_and_exploration_of_film_properties.pdf (383 kB)

03/04/2026 Type A Gelatin

SIMON FETHERSTON - Mar 04, 2026, 11:32 AM CST

Title: Tunable physical and mechanical properties of gelatin hydrogel after transglutaminase crosslinking on two gelatin types

Date: 03/04/2026

Content by: Simon

Present: N/A

Goals: Explore into the potential of gelatin as a sponge coating

Citation:

[1] Y. Liu *et al.*, “Tunable physical and mechanical properties of gelatin hydrogel after transglutaminase crosslinking on two gelatin types,” *International Journal of Biological Macromolecules*, vol. 162, pp. 405–413, Nov. 2020, doi: 10.1016/j.ijbiomac.2020.06.185.

Content:

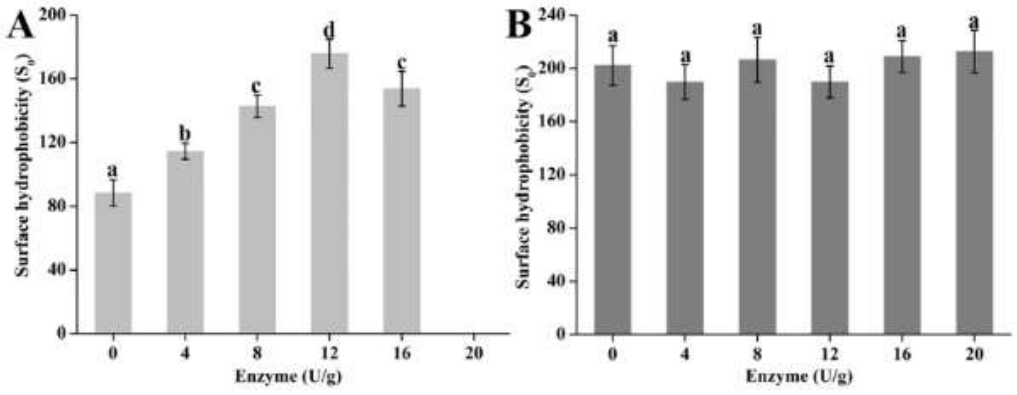
Type-A gelatin - obtained through the acid extraction process

Type B gelatin - extracted by alkali

- Differing isoelectric points
  - Type A corresponds to collagen at pH of 8-9
  - Type B corresponds to collagen at pH of 4.8-5.5

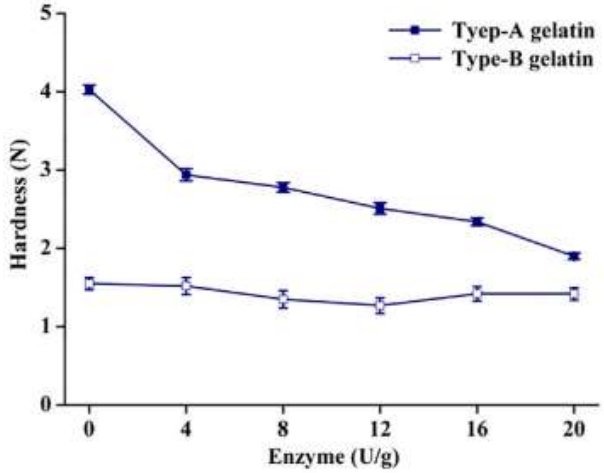
Study compares cross-linking and functional properties of gelatins with MTG (microbial transglutaminase)

- type a gelatin is a preferable substrate for MTG
  - presence of glutamic and aspartic residues
- exposure of hydrophobic groups was increased significantly in type A

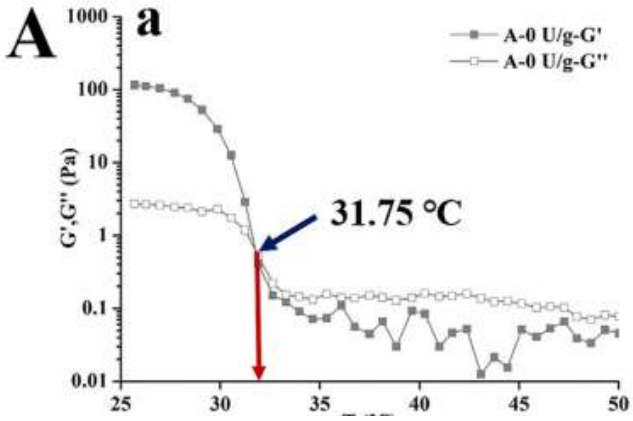


A is type A gelatin and B is type B gelatin

- Results suggest type B has more hydrophobic residues arising in the surface of the protein



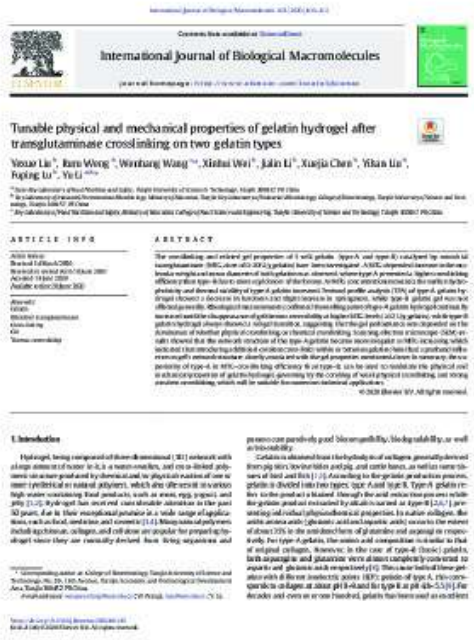
- Hardness of type A gelatin decreased with increasing MTG concentration
  - more enzyme presence could lead to less uniform structures and random linking



  - storage modulus of type a gelatin significantly decreases greater than 30 C

Conclusions/action items: This paper is useful at looking into the properties of Type A and Type B gelatin. The hardness properties of type A gelatin are promising at providing a film/capsule capable to keeping a sponge compressed. The storage modulus was also significantly decreased at higher temps. A combination of body temp and slightly acidic conditions within the cavity could lead to degradation. Type A gelatin is a promising material as it can provide mechanical strength and degrade in the desired conditions.

- Explore costs of materials
- Continue research on materials



International Journal of Biological Macromolecules

Tunable physical and mechanical properties of gelatin hydrogel after transglutaminase crosslinking on two gelatin types

Yexuan Liu, Ruru Wang, Wenhang Wang, Xinhui Wei, Jalin Li, Xuejia Chen, Yihan Liu, Fuping Lu, Ye Li

ARTICLE INFO

ABSTRACT

1. Introduction

[Download](#)

Gelatin.pdf (2.44 MB)

03/11/2026 Gelatin Fabrication

SIMON FETHERSTON - Mar 11, 2026, 11:13 AM CDT

Title: Gelatin-based materials: fabrication, properties and applications in the food packaging system

Date: 03/11/2026

Content by: Simon

Present: N/A

Goals: Research fabrication and cross-linking methods for gelatin

Citation:

[1] X. Xu, Y. Xi, and Y. Weng, “Gelatin-based materials: fabrication, properties and applications in the food packaging system,” *RSC Adv*, vol. 15, no. 37, pp. 30605–30621, doi: 10.1039/d5ra03325j.

Content:

Gelatin extraction techniques:

- ultrasound-assisted extraction - destroys cells, increases mass transfer of cell contents
- enzymatic extraction - partial hydrolysis of collagen through proteolytic enzymes (pepsin, prosubtilis protease, trypsin)
- high pressure extraction - allows more acid to penetrate material
- ohmic heating - electrical energy is converted into heat energy and heats the extraction medium

Crosslinking:

- cross-linking from van der Waals and hydrophobic interactions
  - generally reversible
- dehydrothermal treatment - condensation reaction at high temperatures to form intramolecular cross-links
  - for nanofiber films
- microwave - wavelength of 0.1 mm to 1 m and frequency of 300 MHz to 3000 GHz
  - changes conformation of proteins due to the rapid increase in temperature and dipole rotation of polar molecules
- chemical
  - aldehydes - aldimine condensation between the aldehyde group and the ε-amino groups of lysine and hydroxylysine residues in the gelatin chain to form Schiff base intermediate
    - safety and cytotoxicity is a concern
  - polyphenols - hydrogen bonding, covalent bonding, and hydrophobic reactions
    - more ordered structure than pure gelatin
  - polysaccharides - aldehyde groups of oxidized polysaccharides can form covalent amide bonds with the amino groups of gelatin, thus enhancing the mechanical, wettability, and hygroscopic properties of gelatin nanofibers
- enzymatic - advantages like stable product structure, high selectivity and substrate specificity, mild reaction conditions and sustainable enzyme source

Forms of gelatin in food packaging

- film - solution casting or extrusion molding
  - starch and gelatin molecules were added to 70-100 C water to dissolve, cooled, and cast to prepare a mixed film (solution casting is feasible for this project) - *Nur Amila Najwa I. S. Guerrero P. de la Caba K. Nur Hanani Z. A. Food Packag. Shelf Life. 2020;26:100583. doi: 10.1016/j.fpsl.2020.100583.* [DOI] [Google Scholar][Ref list]
- hydrogel - colorimetric hydrogels, hydrogel absorbent pads and hydrogel films
- nanofiber films - electrospinning
- coating - protection against UV radiation, regulate moisture, and maintain an internal balance between solutes and gases

Conclusions/action items: For this project, creating a film through solution casting seems possible. Using a polyphenol crosslinker could help achieve higher mechanical properties. Research will be conducted to find a specific solution casting fabrication method.

- research solution casting fabrication protocol

SIMON FETHERSTON - Mar 11, 2026, 10:50 AM CDT

RSC Advances

ROYAL SOCIETY OF CHEMISTRY

REVIEW

Gelatin-based materials: fabrication, properties and applications in the food packaging system

1. Introduction

Download

Gelatin_Fabrication.pdf (865 kB)

03/11/2026 Performance Comparison

SIMON FETHERSTON - Mar 13, 2026, 10:45 AM CDT

Title: Performance comparison of glycerol-plasticized type A and type B gelatin films and their suitability for food packaging

Date: 03/11/2026

Content by: Simon

Present: N/A

Goals: Understand the fabrication and mechanical properties of gelatin

Citation: [1] Q. Zhang, J. Zhang, Q. Ping, Z. Sui, and H. Li, “Performance comparison of glycerol-plasticized type A and type B gelatin films and their suitability for food packaging,” Polymer, vol. 343, p. 129389, Jan. 2026, doi: 10.1016/j.polymer.2025.129389.

Content:

Materials: Type A and Type B gelatin, 99% glycerol

Preparation:

- 5.0 g of Type A and Type B gelatin powder were weighed and dissolved in 100 mL of DI water under constant stirring at 50 C
- glycerol was added in proportions of 0%, 20%, 30%, and 40% (w/w, relative to dry gelatin weight)
- continuous stirring for 1.5 hrs
- 100 mL of homogeneous film forming solution was cast onto a 12x12 cm PTFE mold
- After 12h of solidification at room temp, the modified films were transferred to a drying oven and maintained at 50 C for 12h to create final film

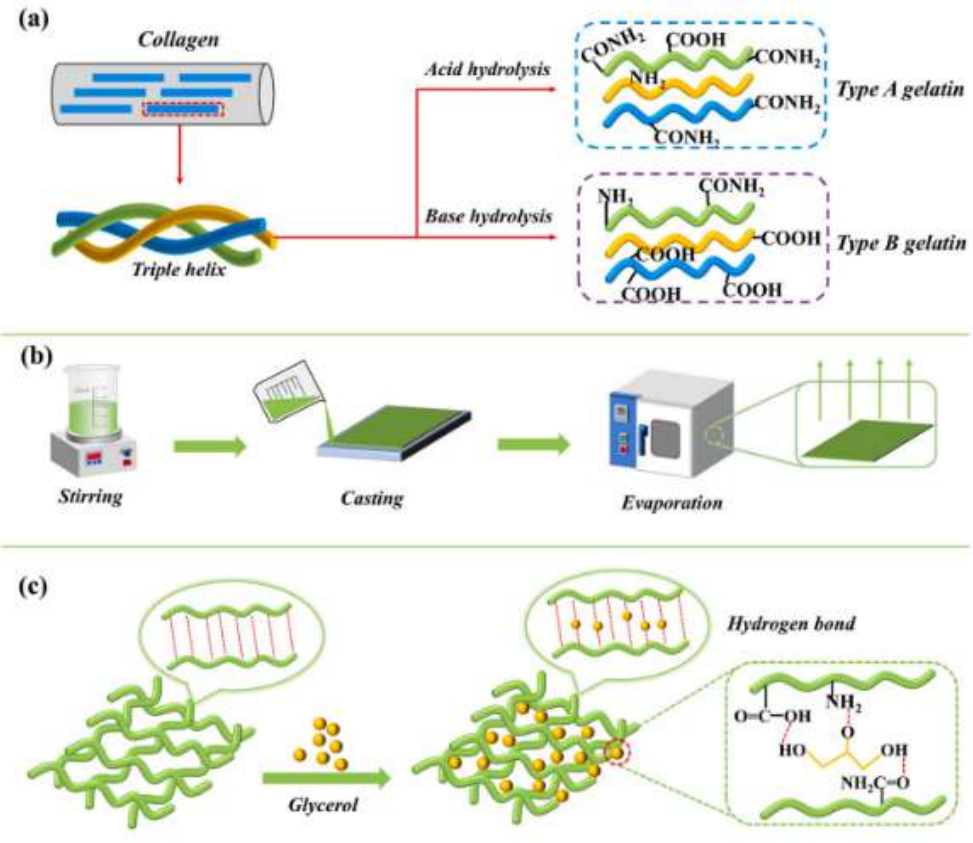


Figure 1. (a) Extraction techniques for each gelatin type. (b) Preparation of gelatin-based films. (c) Mechanism diagram of the interaction between gelatin and glycerol molecules.

Results:

- Amino acid profile of Type A gelatin more closely resembles that of native collagen
  - higher stability of glutamine (Gln) and asparagine (Asn)

    - Type A gelatin has fewer acidic residues, displays a pI of 7.0-9.0
- Type A gelatin had a weight average molecular weight of 18,399 Da while Type B was 1.8 times lower at 9739 Da
    - longer molecular chains are preserved during acid hydrolysis
- At glycerol contents of 20 % and 30 %, Type A gelatin films maintained a uniform and dense morphology - stable hydrogen bonds formed between the amino groups
- With increasing glycerol content, more glycerol molecules embed themselves between gelatin chains, thereby attenuating the native intermolecular interactions within the protein matrix - attributes to wrinkled structures and rough surface at higher glycerol content
- Mechanical properties:
    - Type A gelatin film tensile strength (9.67 ± 1.22 MPa)
    - Type A gelatin film tensile strength (6.18 ± 0.50 MPa)
    - Type A elongation at break (40.3 ± 3.6 %)
    - Type A elongation at break (55.8 ± 3.2 %)

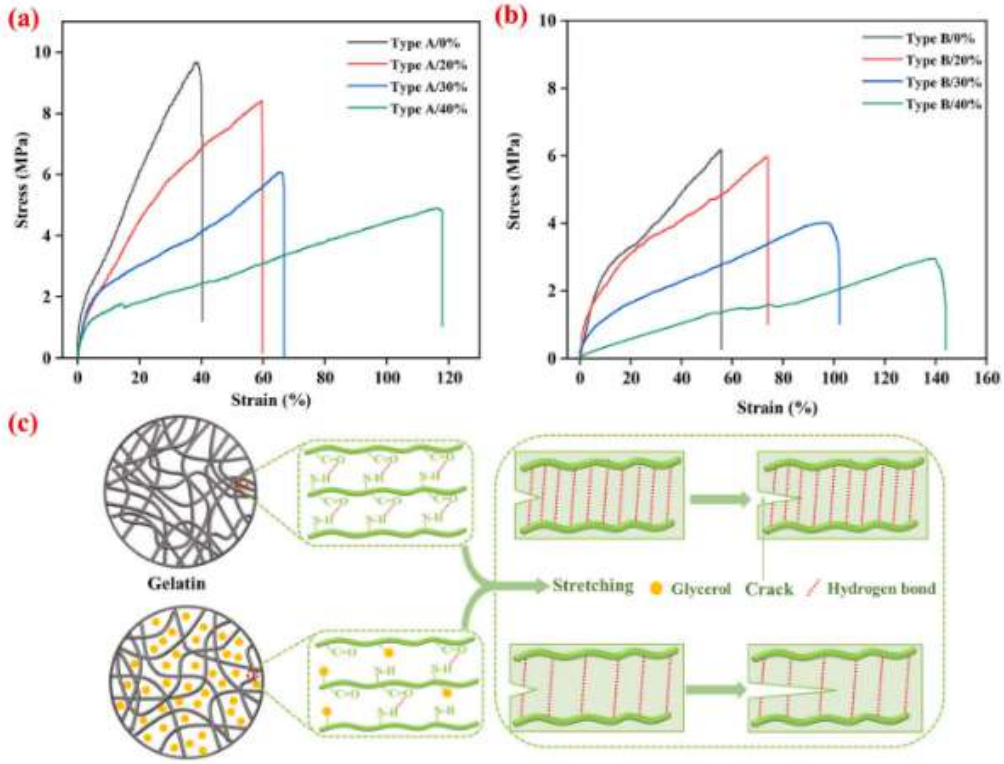


Figure 2. (a) Stress-strain curve for Type A gelatin. (b) Stress-strain curve for Type B gelatin. (c) Stretching mechanism of gelatin-based films.

Type A is a stiffer material than Type B gelatin

Conclusions/action items: This paper is useful for understanding the chemistry and properties of gelatin films. Understanding the chemical makeup will help profile the degradation methods. Also, the mechanical properties will be useful for determining a fabrication plan. A more stiff material is desired to be able to maintain compression of the sponge.

- Research degradation of gelatin


Polymer

Performance comparison of glycerol-plasticized type A and type B gelatin films and their suitability for food packaging

1. Introduction

Download

Gelatin_Performance.pdf (12.6 MB)

03/13/2026 Sodium Alginate

SIMON FETHERSTON - Mar 13, 2026, 12:14 PM CDT

Title: Sodium alginate film: the effect of crosslinker on physical and mechanical properties

Date: 03/13/2026

Content by: Simon

Present: N/A

Goals: Look into sodium alginate at a potential sponge coating

Citation:

[1] S. F. bt Ibrahim, N. A. N. Mohd Azam, and K. A. Mat Amin, “Sodium alginate film: the effect of crosslinker on physical and mechanical properties,” *IOP Conf. Ser.: Mater. Sci. Eng.*, vol. 509, no. 1, p. 012063, Apr. 2019, doi: 10.1088/1757-899X/509/1/012063.

Content:

Alginate polymers

- blocks containing two uronic acids consist of two chain-forming heteropolysaccharides made up of blocks of ß-(1,4)-linked D-mannuronic (M) and a-(1,4)-linked L-guluronic (G) acids.
- Complexes with divalent cations can form gels
  - structure depends on monomer position in the chain
- Great industrial significance as ability to from gels in the presence of divalent calcium ions is a main bio-functional property

Methods - film preparation:

- dissolving 2% (w/v) of sodium alginate (SA) in 80 mL deionized water
- add 50% (w/w) glycerin at continuous stirring for 1 hour and 45 minutes at 60°C
- solution was poured into petri dishes (90 mm (x) 5 mm) and dried in oven at 60°C for 24 hr
- films were peeled off, and immersed in different concentrations of CaCl2 solution, i.e. 0.2M, 0.4M, 0.6M and 0.8M with immersion durations at 2, 4, 6 and 8 minutes
- films were then dried again in oven at 60°C for 24 hr

Methods - swelling:

- Films were immersed in PBS for 24 hours
- Swelling (%) = (Mw-Mo)/Mo (x) 100

Results:

Table 1. Swelling degree, water vapour transmission rate and gel fraction of sodium alginate (SA) film by immersion in different concentrations of $CaCl_2$ and duration time.

Molarity $CaCl_2$ (M)	Immersion time in $CaCl_2$ (min)	Swelling degree (%)	WVTR (g m^{-2} d^{-1})	Gel fraction (%)
0.2	2	54 ± 1.8	2137	20 ± 1.2
	4	22 ± 0.8	2582	22 ± 1.8
	6	31 ± 1.7	3171	19 ± 1.1
	8	26 ± 0.9	3115	21 ± 0.9
0.4	2	43 ± 1.4	1837	24 ± 1.6
	4	42 ± 2.0	1966	23 ± 1.2
	6	40 ± 1.8	2209	26 ± 1.3
	8	31 ± 2.1	2412	27 ± 0.6
0.6	2	44 ± 1.3	1504	23 ± 0.8
	4	43 ± 1.3	1835	25 ± 1.5
	6	34 ± 1.2	2037	26 ± 0.3
	8	27 ± 1.7	2214	28 ± 0.7
0.8	2	69 ± 1.4	1156	26 ± 1.2
	4	64 ± 1.5	1535	28 ± 1.2
	6	51 ± 1.3	1738	28 ± 0.9
	8	51 ± 1.2	1870	33 ± 1.6

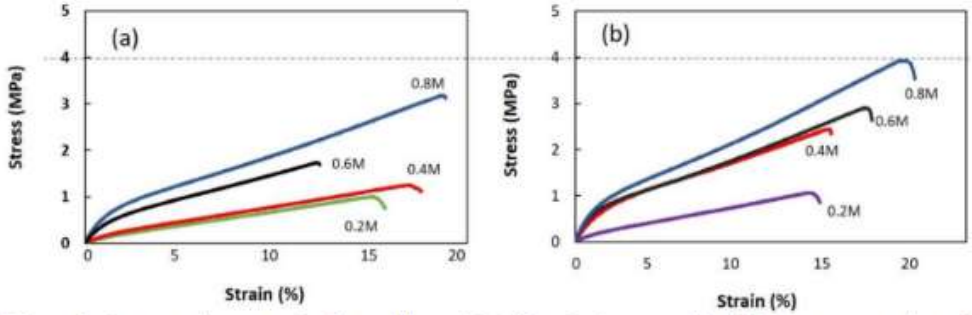


Figure 1. Stress-strain curve of sodium alginate (SA) film after immersed in different concentrations of calcium chloride solution for (a) 2 min and (b) 8 min.

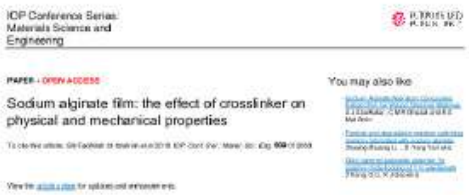
Table 2. The tensile stress (σ), tensile strain (ε) and Young's modulus (YM) of sodium alginate film immersed in different concentration $CaCl_2$ for 2 and 8 min of contact time

Molarity $CaCl_2$ (M)	Period (min)	σ (MPa)	ε (%)	YM (MPa)
0.2	2	1.00 ± 0.2	15.21 ± 1.1	8.26 ± 2.3
	8	1.05 ± 0.2	15.19 ±1.5	9.23 ± 0.6
0.4	2	1.25 ± 0.2	16.90 ± 2.5	9.64 ± 2.0
	8	2.43 ± 0.2	16.25 ± 1.0	20.96 ± 10.6
0.6	2	1.82 ±0.2	12.22 ± 3.2	17.88 ± 6.1
	8	2.90 ± 0.5	18.63 ± 3.1	24.26 ± 12.1
0.8	2	3.14 ±1.2	18.83 ± 3.0	24.97 ± 10.2
	8	3.92 ± 0.3	21.08 ± 1.3	27.81 ± 7.5

0.8 M CaCl2 immersion of 2 minutes had the highest degree of swelling as well as the greatest ultimate strength. These characteristics are important to consider for the design.

Conclusions/action items: This paper is useful at identifying the use of sodium alginate as a potential coating material. The mechanical properties of the film seem likely to be able to maintain sponge compression. Further research should be done to determine the degradation method and time. However, the high degree of swelling is promising to allow for faster degradation.

SIMON FETHERSTON - Mar 13, 2026, 11:06 AM CDT



IOP Conference Series: Materials Science and Engineering

PAPER • OPEN ACCESS

Sodium alginate film: the effect of crosslinker on physical and mechanical properties

You may also like

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Sodium_Alginate.pdf (847 kB)

03/13/2026 Glycerin Safety Data Sheet

SIMON FETHERSTON - Mar 13, 2026, 10:54 AM CDT

Title: Glycerol (commercially Glycerin) Safety Data Sheet

Date: 03/13/2026

Content by: Simon

Present: N/A

Goals: Display important information regarding the use of glycerin

Content:

The attached PDF includes the safety data sheet. It is important to note that Sigma-Aldrich recommends a Filter A-(P2) when when vapors/aerosols are generated. For our use, a fume hood will suffice for controlling potential vapors.

Conclusions/action items: This safety data sheet will be important to look back on to see the properties of the product as well as proper safety measures. Since the glycerin will be evaporated in the oven, the oven in the fume hood must be used. This will contain the vapors and prevent potential harmful effects to people in the lab.

SIMON FETHERSTON - Mar 13, 2026, 10:55 AM CDT


Sigma-Aldrich.

SAFETY DATA SHEET

SECTION 1. IDENTIFICATION

1.1 Product identifiers

Product name : Glycerol

Product Number : G9012
Brand : Sigma-Aldrich
CAS-No. : 56-81-5

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Synthesis of substances

1.3 Details of the supplier of the safety data sheet

Company : Sigma-Aldrich Inc.
3050 SPRUCE ST
ST. LOUIS MO 63103
UNITED STATES

Telephone : +1 314 771-5765
Fax : +1 800 325-5052

1.4 Emergency telephone number

Emergency Phone # : 800-424-9300 CHEMTREC (USA) +1-703-527-3887 CHEMTREC (International) 24 Hours/Day; 7 Days/Week

SECTION 2. HAZARDS IDENTIFICATION

GHS classification in accordance with the OSHA Hazard Communication Standard (29 CFR 1910.1200)

Hazards for the product as supplied

Not a hazardous substance or mixture.

Other hazards

None known.

GHS label elements

No hazard pictogram, no signal word, no hazard statement(s), no precautionary statement(s) required.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Sigma-Aldrich - G9012

Page 1 of 14

The life science business of Merck KGaA, Darmstadt, Germany operates as MilliporeSigma in the US and Canada

MilliporeSigma

Download

Glycerin_Safety_Data_Sheet.pdf (375 kB)

02/06/2026 Existing Training Models for Endoscopy

SIMON FETHERSTON - Feb 06, 2026, 11:44 AM CST

Title: Existing Training Models for Endoscopy

Date: 02/06/2026

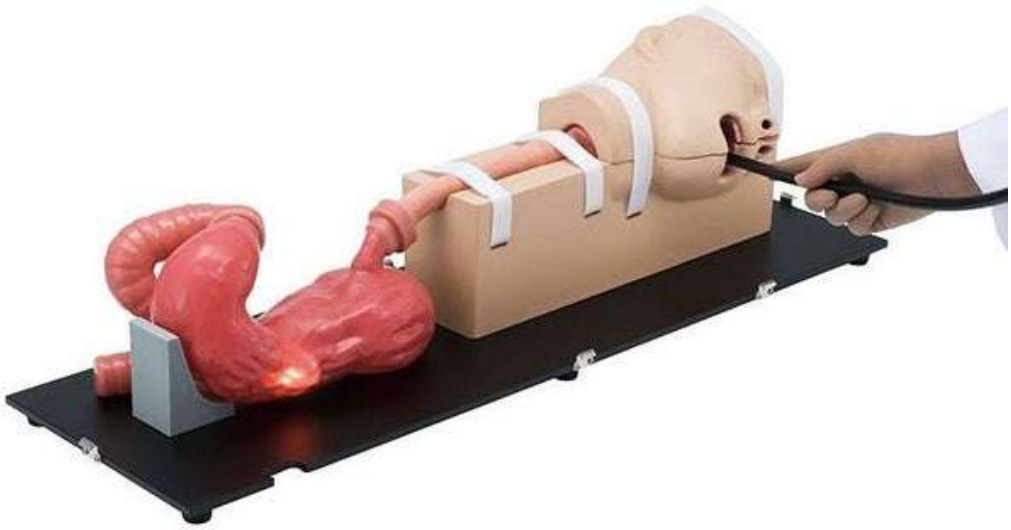
Content by: Simon

Present: N/A

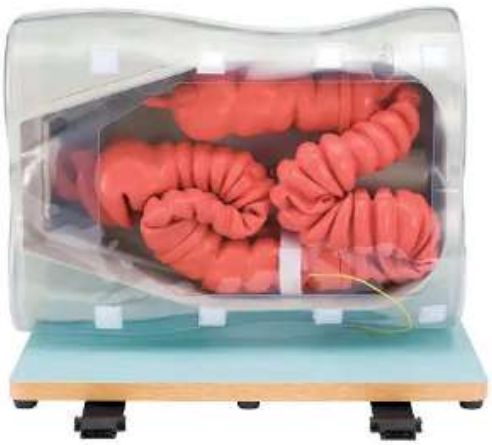
Goals: Show potential ideas of models that could be used to help the design process and testing of a design/prototype

Content:

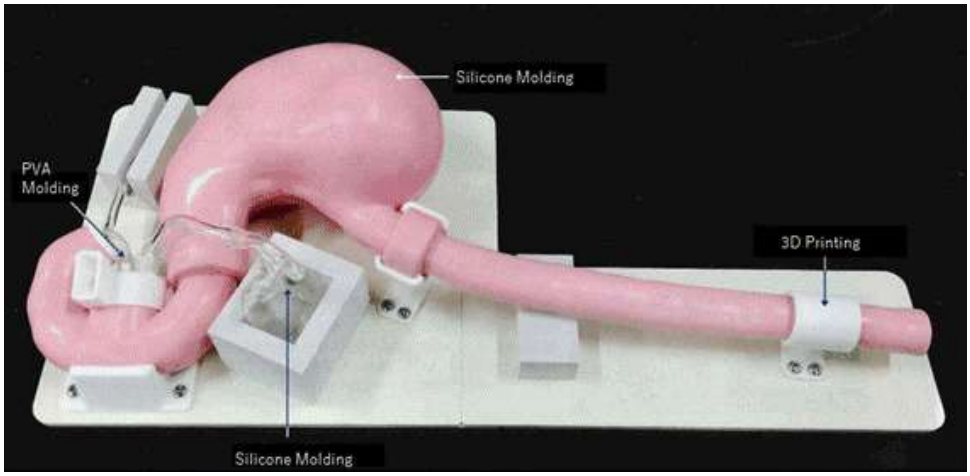
Koken EGD (Esophago-Gastro-Duodenoscopy) Simulator



Training simulator LM-107



Yasijoma training model



Conclusions/action items: These different training models are used to practice endoscopy skills. The team could create a similar model to help guide the design process by actively testing feasibility. The model could also be used once a prototype is developed to test its use. These ideas will be presented at a team meeting to see if such an idea could aid in the design/testing of the project.

- show team the endoscopy training models

02/11/2026 Stent Sponge

SIMON FETHERSTON - Feb 11, 2026, 5:20 PM CST

Title: Stent Sponge

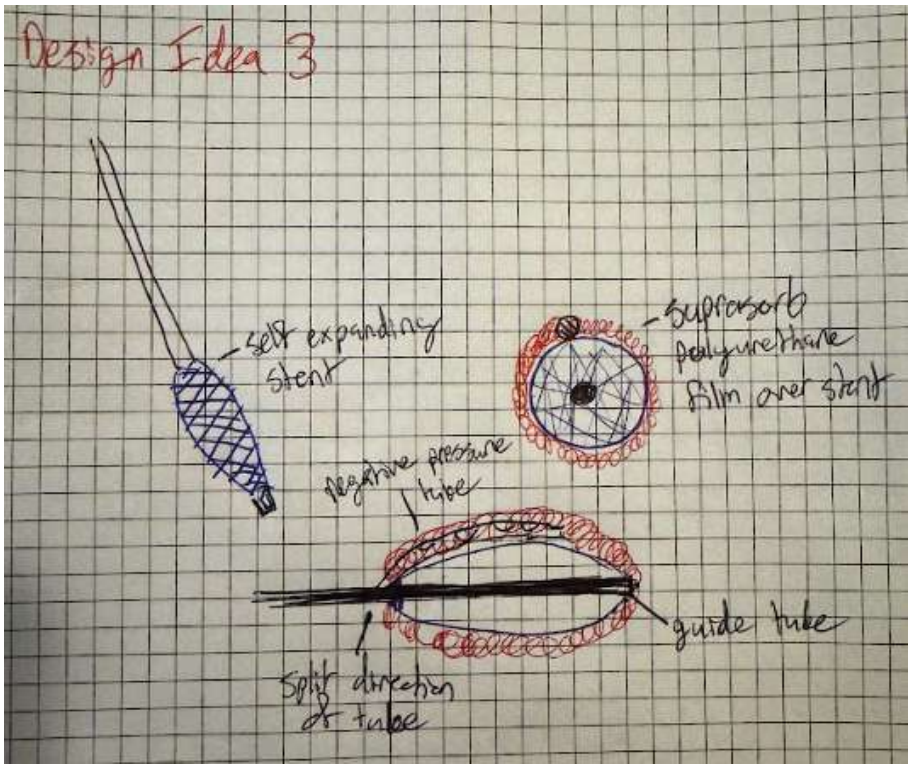
Date: 02/11/2026

Content by: Simon

Present: N/A

Goals: Show design idea

Content:



Conclusions/action items: This design uses a stent to apply pressure and expand the sponge to fill the cavity. Potential challenges include difficulty expanding stent and applying negative pressure to the sponge without affecting the stent. It is also important to consider the the resources available to prototype which may make it difficult to create a working stent.

- create design matrix

02/11/2026 Encapsulated Sponge

SIMON FETHERSTON - Feb 11, 2026, 5:24 PM CST

Title: Encapsulated Sponge

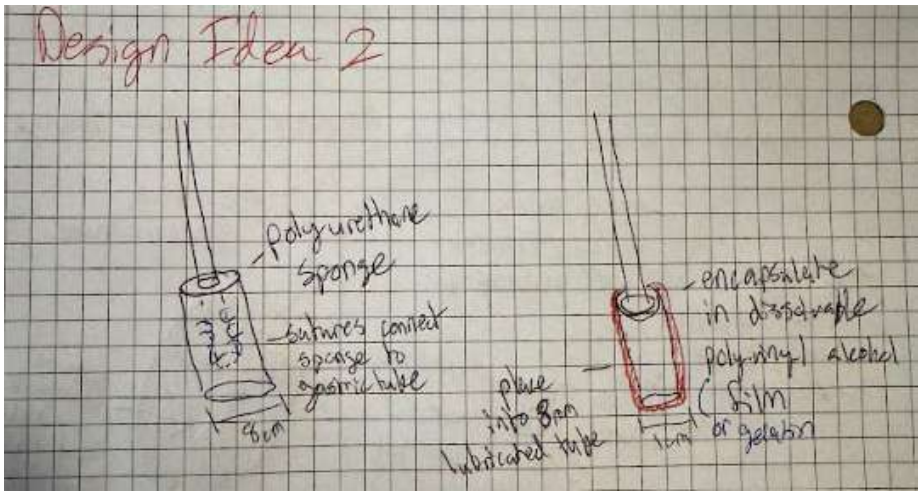
Date: 02/11/2026

Content by: Simon

Present: N/A

Goals: Show design idea

Content:



Conclusions/action items: This design features a polyvinyl alcohol or gelatin film. This film is meant to collapse the sponge to a smaller size to allow easier insertion. Once the sponge reaches the correct location, the biodegradable materials will break down and allow the sponge to expand and fill the cavity. The challenge with this design could be the mechanical strength of the film as it may not be able to keep the sponge compressed. Also, the film must be able to degrade rapidly in the esophagus once it is placed.

- Create design matrix

02/11/2026 Guide Tube

SIMON FETHERSTON - Feb 11, 2026, 5:28 PM CST

Title: Guide Tube

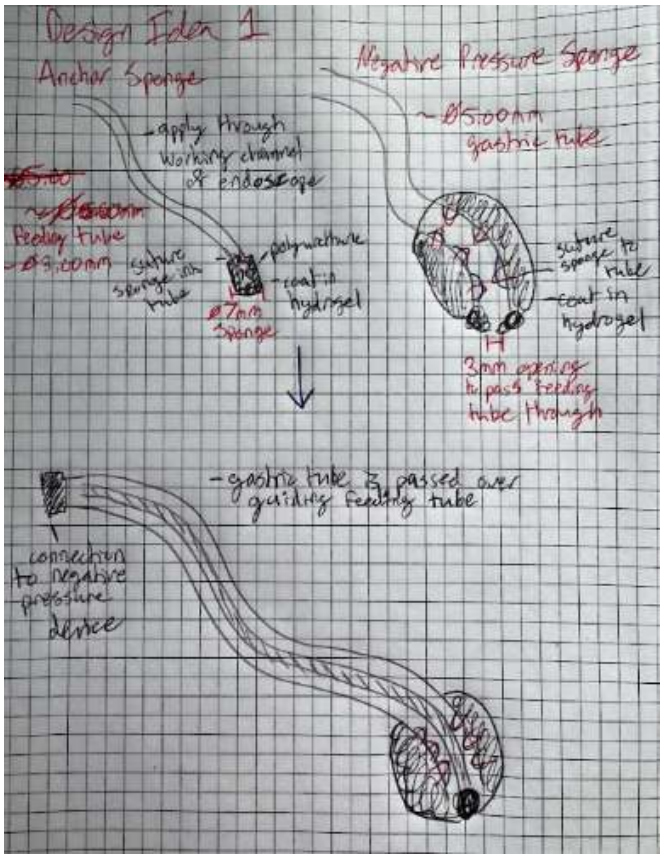
Date: 02/11/2026

Content by: Simon

Present: N/A

Goals: Present design idea

Content:



Conclusions/action items: This design focuses on using a smaller diameter tube to locate the cavity. A larger tube with the sponge can be thread over the smaller tube and be placed in the correct location. A challenge with this design could be its size and maneuverability. This design is the most feasible to create within the time constraint of a semester.

- Create design matrix

04/28/2026 Sponge Mold Design

SIMON FETHERSTON - Apr 28, 2026, 6:14 PM CDT

Title: Sponge Mold Design

Date: 04/28/2026

Content by: Simon

Present: N/A

Goals: Display sponge mold design

Content:

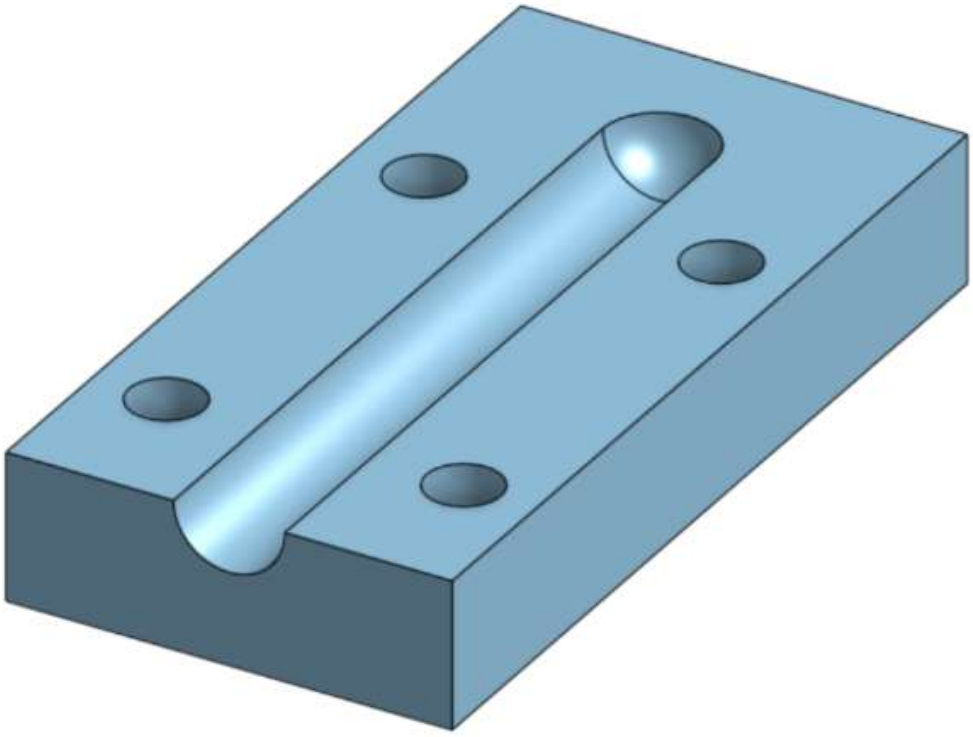


Figure 1: Bottom plate for sponge mold.

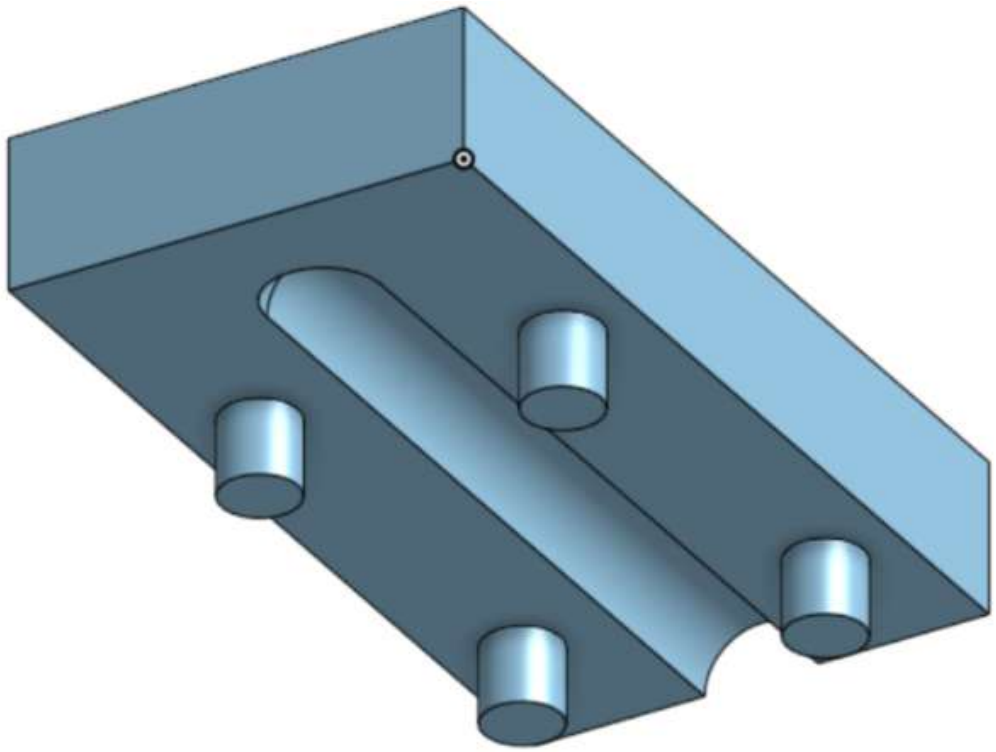


Figure 2: Top plate for sponge mold

The two plates connect together to seal a sponge with a gelatin film. The film is wrapped around the sponge and placed inside the molds, where the two plates are then connected. The length of the mold is 7 cm and the diameter is 1.5 cm. These dimensions match the necessary dimensions to cover the side ports on the NG tube as well as be small enough to fit within the esophagus.

Conclusions/action items: This mold was printed but not used for sponge fabrication. Since each plate had the same 0.75 cm radius, the gelatin would slip out before the top plate could apply compression. Revisions to this design would be to have one plate be deeper than the other, allowing the gelatin to be wrapped around the sponge and remain within the cavity when the top plate is applied.

02/27/2026 Machining Training

SIMON FETHERSTON - Feb 27, 2026, 12:45 PM CST

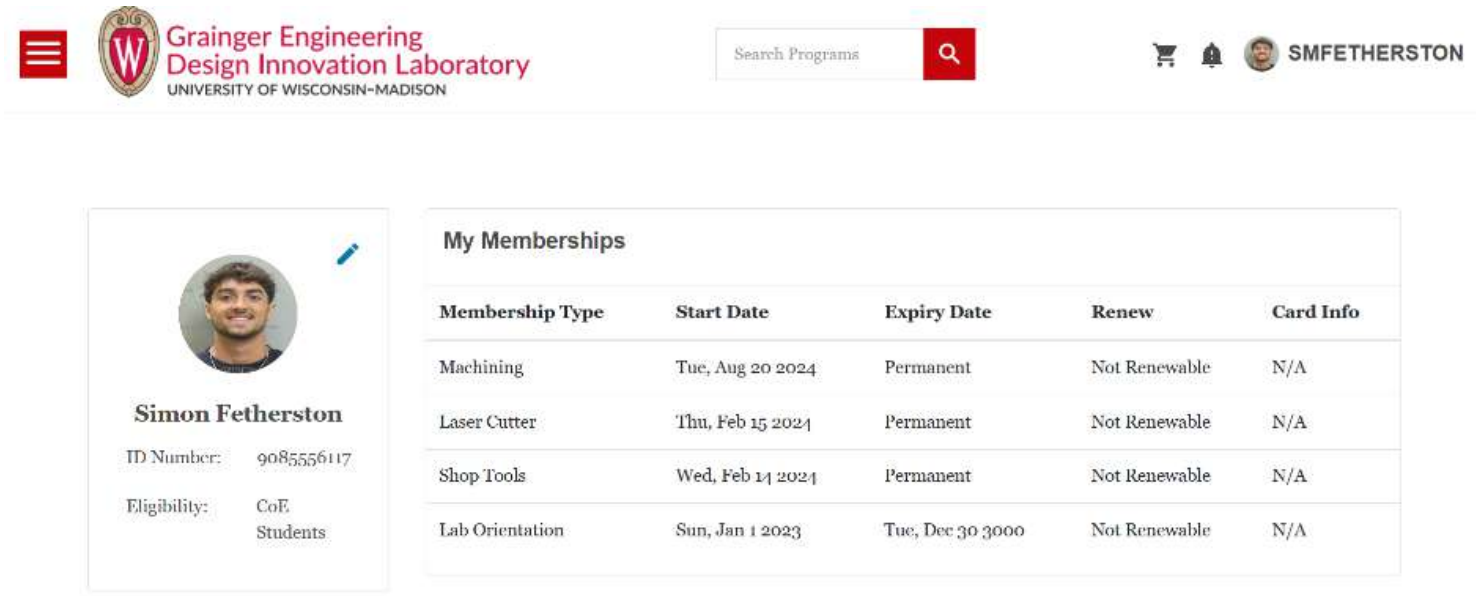
Title: Completed Training for Machining and Shop Tools

Date: 02/27/2026

Content by: Simon

Goals: Completed training from all semesters (InterEGR 170 to BME 200)

Content:



02/27/2026 Biosafety and OSHA Training

SIMON FETHERSTON - Mar 09, 2026, 9:10 AM CDT

Title: Completed Training for Biosafety and OSHA Chemical Safety

Date: 02/27/2026

Content by: Simon

Goals: Completed training from all semesters (BME 200 to BME 201)

Content:

OVCR Training Information Lookup Tool — University of Wisconsin-Madison

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UNIVERSITY OF WISCONSIN-MADISON

This certifies that Simon Fetherston has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/22/2025	1/22/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	11/14/2024	
Unanticipated Problems	HSR Optional Courses	5/29/2025	

Data Last Imported: 02/25/2026 12:56 PM

03/09/2026 CITI Training

SIMON FETHERSTON - Mar 09, 2026, 9:11 AM CDT

Title: Completed CITI Training

Date: 03/09/2026

Content by: Simon

Goals: Completed training from all semesters (BME 200 to BME 301)

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

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Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/22/2025	1/22/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	11/14/2024	
Unanticipated Problems	HSR Optional Courses	5/29/2025	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	3/6/2026	3/6/2029

Data Last Imported: 03/09/2026 07:55 AM

03/20/2026 Disposing of Hazardous Chemicals Training

SIMON FETHERSTON - Mar 20, 2026, 10:13 PM CDT

Title: Disposing of Hazardous Chemical Training

Date: 03/09/2026

Content by: Simon

Goals: Complete disposing of hazardous chemicals training for BME 301

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

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This certifies that Simon Fetherston has completed training for the following course(s):

Course	Assignment	Completion	Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	1/22/2025	1/22/2030
Chemical Safety: The OSHA Lab Standard	Final Quiz	11/14/2024	
Disposing of Hazardous Chemicals	Final Quiz	3/20/2026	3/20/2031
Unanticipated Problems	HSR Optional Courses	5/29/2025	
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	3/6/2026	3/6/2029

Data Last Imported: 03/20/2026 05:56 PM

2026/01/28 - Lecture 1 - Library

Evelyn Mikkelson - Jan 28, 2026, 1:56 PM CST

Title: Article Searching, Source Evaluation, and Citation Management

Date: 2026/01/28

Content by: Evelyn Mikkelson

Goals: Learn more about library resources and how to use them.

Content:

AI

- Not search engines, predictive chat generators
- Can generate factually incorrect statements and make up sources
- Do not respond to prompts consistently
- Trained on undisclosed data

Library Website

- Engineering category and more focused databases
- Scopus - multidiciplinary
- Adding search fields to narrow topic
  - Keywords
  - Years
  - Article type
- Author and indexed keywords from article
  - Can also use as filter
- 24 hours - 3 days to get full text once requested

Zotero

- On webpage save to Zotero
- Can pick a folder and click done
- In Zotero is highlighted and has all citation information that can be edited
- Can make notes, add tags
- Can start group library
- Add things manually
- Has menu option in word to add citations and bibliography

Library Resources

- Link on canvas page

Evaluating Sources

- Relevance, authority, quality, currency
- Read laterally

Technical Reports

- Government funded research reports
- Have to include all results, they are updates on the research
- Freely available because they are government documents

Conclusions/action items:

Use library website and Zotero to continue doing research for the project. Make a group Zotero to keep track of citation for PDS and reports. Complete literature review for this weeks notebook check

2026/02/04 - Lecture 2 - Resume and Cover Letter

Evelyn Mikkelson - Feb 04, 2026, 2:15 PM CST

Title: Resume and Cover Letter

Date: 2026/02/04

Content by: Evelyn Mikkelson

Goals: Improve my cover letter and resume.

Content:

Rubric for Peer Review

- Key terms in job description --> cover letter/resume
- Positive, improvement, expand on
- Submit single picture rubric - cover letter annotations - resume annotations (2)

Conclusions/action items:

Make sure to submit files before end of class and use rubric evaluations to make edits to my resume and cover letter to submit to canvas.

2026/02/11 - Lecture 3 - Presentation Tips and Job Interviews

Evelyn Mikkelson - Feb 11, 2026, 2:07 PM CST

Title: Presentation Tips and Job Interviews

Date: 2026/02/11

Content by: Evelyn Mikkelson

Goals: Improve presentation and interview skills.

Content:

Upcoming

- Bring copy of slides next week for peer review
- Next Friday preliminary presentations

Presentation Tips

- Alignment of bullet points and never have hanging
- Consistent font and font size
- Logical flow - not always chronological
  - Design ideas presented in same order throughout
- Use pictures that will discuss
- Keep audience interested
  - Be excited, use project impact to stimulate interest
  - Talk to audience
- Design matrix
  - Hit highlights
  - List important criteria first and give highest weight
- Descriptive short titles
- Figure captions
  - Number - what is it - what is it showing
- CAD
  - Use clear images instead of drawing with dimensions
  - Labels and scale required
- Sketches
  - Remove background
  - Clean lines
  - Labels and scale required
- Results
  - Graph it
  - Appropriate font and axis values
  - Show statistical analysis

Job Interviews

- Bring small portfolio
- How to stand out

    - Be specific and personal
    - Technical and soft skills
- Be prepared to answer common questions with specific answers
- Ask thoughtful questions that demonstrate you researched them

Activity

- Pick 3 questions and type response under question
- Share with group and get notes
- Upload document by end of day
- Q1. I am pretty introverted, so it can be hard for me to ask questions and seek clarification. This is something that I have been working on for a while, but as I complete more design projects, it has become a lot easier. I have gained confidence in my knowledge and become more comfortable communicating in a team setting because I have more experience with them. I have also become more comfortable in presentations because I am around it more and spend time really getting to know the project.
- Q2. My most recent project was creating a diaper that could separate stool and urine, and from it I learned a lot about problem solving. I was the designated sewer on the team, so I very quickly learned how to sew a diaper. I kinda just jumped into it right away and started cutting up and sewing parts into diapers and made mistakes, so I wouldn't make them later on, for example not sewing the diaper together. We also had problems figuring out how to test the prototype because we could not work with real babies and the model we had was a CPR training device. After talking with advisors and peers we decided to 3D print a model, so I got to troubleshoot SolidWorks learning how to 3D print a baby. At the end we had a prototype the client was happy with, and that's all you can ask for.
- Q6. Last semester, the design project I was working on was a diaper, and I remember getting ready for preliminary presentations I had to sell my group on the importance of the design. For me it was just giving them reminders that this device is treating the number one cause of death in children in low income countries. Additionally making sure they were confident in the designs, and if they weren't trying to explain through the use of a previous prototype.

Conclusions/action items:

Fill out other questions as practice. Make sure to employ presentation tips in our preliminary presentations.

2026/02/18 - Lecture 4 - Presentation Peer Review

Evelyn Mikkelson - Feb 18, 2026, 1:34 PM CST

Title: Presentation Peer Review

Date: 2026/02/18

Content by: Evelyn Mikkelson

Goals: Get feedback on the current presentation slides and make changes before Friday.

Content:

Feedback Fruits, Deliverables

- Posted, by the end of next week Wednesday and reflection Sunday
- Same day as preliminary deliverables
- Friday 10am presentation uploaded
- Individual conferences next week Friday

Peer Review

- Trade with other team and take picture of annotations to submit
-

Conclusions/action items:

Make changes to slides before Friday according to peer feedback.

2026/02/25 - Lecture 5 - Diversity and Inclusion in Design

Evelyn Mikkelson - Feb 25, 2026, 2:08 PM CST

Title: Presentation Peer Review

Date: 2026/02/25

Content by: Evelyn Mikkelson

Goals: Apply diversity and inclusion into our design.

Content:

Diversity in Engineering Design

- Inclusion
- Consideration of others - socioeconomic status
- Adapting designs - accommodation for sizing
- Acknowledgement that people have different backgrounds and strengths
- Cultural and religious beliefs
- Testing in multiple demographics

Universal Design

- Sizing accommodation - adjustable
- Religious and culture considerations
- Cost barriers
- Age barriers
- Location
- User friendly - intuitive
- Ergonomics
- Flexibility of design
- Definition useable by all people to the greatest extent possible without need for adaptation or specialized design
- 7 Principles
    - Equitable use
    - Flexibility of use
    - Simple and intuitive
    - Perceptible (communication) information
    - Tolerance for error
    - Low physical effort
    - Size and space for approach and use

Ethics

- Design for more people -> help more people

Conclusions/action items:

Continue consideration of inclusivity and universal design for our project.

2026/03/04 - Lecture 6 - Patents and Standards

Evelyn Mikkelson - Mar 04, 2026, 2:08 PM CST

Title: Patents, Standards, and Other Resources for Design

Date: 2026/03/04

Content by: Evelyn Mikkelson

Goals: Learn more about where to find patents and standards related to our design

Content:

Standards

- ASTM - all ASTM, some ISO and IEC
- ASABE
- IEEE
- Historical print collection
- ASSIST quick search, FDA are freely available online

Market and Industry

- Companies, industries, consumer trends
- Research guides for company, industry, and market
- Data Axle Reference Solutions - directory for business, lifestyle, demographics
- IBISWorld Industry Reports - broad reports on industries, market flow
- ProQuest One Business - journals, reports
- Executive summary - Tong Award need to do business analysis

Patent and Prior Art

- Prior art: inventions disclosed in US or foreign patents or patent application, publications, currently for sale or public use
- Squngee: https://www.lens.org/lens/patent/003-175-616-265-36X/frontpage?l=en
  - Citations
  - Searching keywords from title or abstract
  - CPC classification
- Usefulness, novelty, non-obviousness
- Claim: what is legally enforceable, preamble -> transition -> antecedent basis (list)
  - Independent: stand alone, contain limitations to define invention
  - Dependent: refer to independent claim to further limit it
- Evaluation Squngee vs Squirrel Bungee Apparatus
  - Squngee uses animals instead of squirrels
  - Different mechanisms
  - Patent expired - can market

Conclusions/action items:

Use these resources to continue research on our design and project.

2026/03/06 - Tong Lecture - Imagination to Implantation

Evelyn Mikkelson - Mar 06, 2026, 1:26 PM CST

Title: Imagination to Implantation: Turning Science Fiction Into Brain Technologies

Date: 2026/03/06

Content by: Evelyn Mikkelson

Goals: Learn more about Justin Williams and his background and businesses.

Relfection:

I really like the Tong Lecture because I get to know what faculty members are doing outside of teaching and research labs. I really enjoyed getting to learn more about the different inventions he has contributed to. I appreciated that he included his background and went through his experiences because I am also from a small town. Overall, I found his lecture really interesting and am glad that he was able to covey all the difficult concepts of his designs in a way I could understand.

2026/03/11 - Lecture 7 - Protocol Development

Evelyn Mikkelson - Mar 11, 2026, 1:46 PM CDT

Title: Protocol Development

Date: 2026/03/11

Content by: Evelyn Mikkelson

Goals: Learn more about what protocols should look like and what are team needs to do for testing and fabrication protocols.

Content:

Fail Fast and Fail Forward

- Document all prototypes
- Consider using left over materials
- Check 1080 closet
- Test individual components

Preliminary Testing and Analysis

- Connection points - testing different attachments/fittings
- Simple calculations (forces)
- Free body diagrams
- Mechanics of materials - strength, elasticity

Planning

- Keep track of everything done and built
  - Document in protocol in notebook - materials and full name of methods/machines used
  - Expense table with everything used in process and final prototype
  - References in protocols and notebooks so easy to find where information came from
  - Dimensions, concentrations, observations
- Has to be repeatable

Sample Protocols

- 1: how to mix items (what does it look like/time), machines/tools used, specific information on products, what is range
- 2: what is size of large, how they measured pH
- 3: units, tablet composition, tablet dimensions/pictures/observation

3D Printing

- Include gCode file in notebook
- Layer thickness, infill, speed, support type/style

Manufacturing

- Consider entire process

- Can not manufacture everything you can 3D print
- Molding, machining, subtractive manufacturing, joining

Professional Advice

- Design innovation lab
    - Consultations
- Faculty

Fabrication Plan

1. Name of fabrication step/portion of prototype:
   Date to be completed:
   Team member(s) fabricating:
   Detailed sketch of portion of prototype being fabricated (Include dimensions)!:
   Detailed bulleted steps of fabrication:

2. …

Testing Plan

- 3 professional people to test it - aim for above 6
- What controls are needed - negative, positive, experimental
- Testing for precision and accuracy
    - Fixtures for MTS
    - Code for analysis
- Reference PDS
- Match fabrication plan - each component fabricated needs to be fabricated, do not wait until end

Conclusion:

Take this into consideration when making future protocols and continued documentation in notebook.

2026/03/18 - Lecture 8 - Communication

Evelyn Mikkelson - Mar 18, 2026, 1:39 PM CDT

Title: Brevity in Communication

Date: 2026/03/18

Content by: Evelyn Mikkelson

Goals: Learn more about show and tell call to action and how to write it well

Content:

Elevator Pitch

- Quickly communicate ideas
- Use an "elevator ride" to pitch
- Know you audience: tailor pitch to interests and needs of audience
- Practice
- Be authentic: let passion and enthusiam show
- Keep it simple: avoid complex and technical language
- Adapt and iterate: be open to feedback
- Attention grabber, brief introduction, value proposition (what you offer and problem you are solving), highlight key aspects, end with call to action
    - Immediately let them know what you are looking for (show and tell)
    - Don't waste time with unnecessary background (show and tell)
    - Did you design something well for needs of user, design process, testing against PDS (Excellence)
    - Does product have good potential market, what is impact, how many people impact, WARF (Tong)
- Do: eye contact, confidence, excitement, tailor pitch to audience, get a feel for interpretation of pitch, adapt
- Don't: go into unnecessary details, listen and engage with audience

Awards/Executive Summary

- Criteria on canvas
- Executive summary and award selection
- Like elevator pitch, one page document
    - Thursday after spring break
- Saying more with less
- Introduction, problem statement, solution, benefits, recommendations
    - Key points for award in canvas document

Abstracts

- Write it last
- Complete summary of work for entire semester
- 150-300 words (250, one paragraph)
- Background/context, objective, methods, results and analysis, discussion, conclusion, future work

Reports

- Eliminate extraneous text: don't explain the obvious, be aware of audience, only provide details for reproduction, remove redundant pairs (end result, important essentials, basic fundamentals)
- Avoid conversational text
- Spell out acronyms once when first introduced
- Remove redundancies
- Do not include raw data in body (can be helpful in appendix)
- Proofread entire document

Conclusion:

Use this going into show and tell and looking forward to the final report and presentation.

2026/03/25 - Lecture 9 - Ethics in Engineering

Evelyn Mikkelson - Mar 25, 2026, 2:09 PM CDT

Title: Ethics in Engineering

Date: 2026/03/25

Content by: Evelyn Mikkelson

Goals: Learn more about ethics considerations for our design project.

Content:

Ethics

- Where ethics come from - life experiences, how you were raised, religion
- Viewing society through different criteria as a person vs as part of a company
  - Personal - self
  - Professional - company determined, code of ethics for BME
- Problem solving
  - Understand problem - generate solutions - test solutions
- Analysis options
  - Harm test
  - Publicity (news) test
  - Reversibility (self) test
  - Universality (society) test
  - Respect for persons
  - Utilitarian (minority group) test
  - Social Justice (negative impact minority group, distribution) test

Questions

- Guidant VPs
  - Continue justification: company is making money, the device can work, only look at success, damage is already done
  - Moral foundations: they are saving more lives than they are harming, shift blame with pre-existing conditions
- Patients and Doctors
  - Arguments to be considered: people are dying/being hurt/injured, knowing the risk vs. reward of treatment, knowing complications to change approach
  - Ethical foundations of perspective: knowing what could go wrong, surgeon reputation, making informed decision about procedure
- Design Engineers
  - What else can they say or do: go to company, go outside (FDA, news), do nothing, strike
  - Arguments that can be made: the company will loose money/reputation if this data comes out, engineers wanting to keep their job
  - What options do they have: just keep doing job, go to public
  - How is each stakeholder affected: VPs reputation, patients and doctors make more knowledgeable

    - BME code of ethics: need to have public trust and be regulatory compliant, transparency, avoid misleading public
    - Tests: does not look good in the news (publicity), would not be good if everyone acted this was (universality), the failures are causing unnecessary surgery and deaths (harm)
    - Best decision: snitch
    - Result: anonymous letters to FDA, $92.4 million criminal penalty, company went under and was bought out
- What components of your design have ethical dimensions?
    - Coating - gelatin being porcine, biocompatibility
    - Procedure - time of surgery, how many times it has to be repeated
    - Patient - needing multiple surgeries, length of treatment, discomfort
- How will your team address the ethical dimensions?
    - Considering materials that have similar structure and properties to gelatin for testing
    - Completing ISO 10993 testing to ensure product is safe for use

Conclusion:

This was an interesting activity to think about ethics in more complex situations. I will incorporate these ideas and perspectives moving forward.

2026/04/08 - Lecture 10 - Engineering Judgement

Evelyn Mikkelson - Apr 08, 2026, 1:39 PM CDT

Title: Engineering Judgement

Date: 2026/04/08

Content by: Evelyn Mikkelson

Goals: Learn more about what engineering judgement is.

Content:

Engineering Judgement

- Back of an envelope calculations
- Orders of magnitude calculations

Learning Engineering Judgement

- Real world problems
- Open ended problem
- Communication
- Teamwork
- Handling uncertainty
- Ask questions
- Embrace life long learning
- Domains: attitudes, behaviors, cognitive

Conclusion:

Complete the activity associated with this lecture.

2026/04/08 - Lecture 11 - Poster Presentations

Evelyn Mikkelson - Apr 15, 2026, 1:45 PM CDT

Title: Poster Presentations

Date: 2026/04/15

Content by: Evelyn Mikkelson

Goals: Learn more about what our final poster and final presentation need to be.

Content:

Printing

- Library system
- Check specifications

Presentation

- Previous lecture
- Design resources on website

Poster

- Good: not overwhelming, flow, having good colors, labeling figures, detailed but concise, limited blank space, alignment, no hanging bullets, pictures
- Bad: raw data, small poster, unexplained data/pictures, small text, a lot of words/clutter, include statistics, mismatch text size/format/font, CAD drawings, redundancy
- Read requirements and evaluation
- Include relevant and correct contact information
- Have storyline/flow
- Show best results
- Minimize text (bullets)
- Relevant pictures
- Caption = figure label + title(sometimes, not required) + description + citation
- Read text from 3ft (except references and acknowledgment) (24-28 font size)
- User and setting (user device interaction) -> place in larger system (clinic)

Conclusion:

Prepare draft poster for next week lecture to bring for peer review.

2026/04/22 - Lecture 12 - Poster Peer Review

Evelyn Mikkelson - Apr 22, 2026, 1:34 PM CDT

Title: Poster Peer Review

Date: 2026/04/22

Content by: Evelyn Mikkelson

Goals: Get feedback on our poster.

Content:

Poster Session

- BWIG uploads by 10am Friday
- 10am ECB set up and poster up by 11am
- 3pm awards ceremony

FINAL DELIVERABLES WED - do not need to see who wrote what

- 1% grade bump with Heliocampus and google form completion

Conclusion:

Make changes and print tonight.

2026/01/29 Endoscopic Treatment GI Leaks

Evelyn Mikkelson - Jan 29, 2026, 3:50 PM CST

Title: Endoscopic Treatment of Upper Gastrointestinal Postsurgical Leaks: a Narrative Review

Date: 2026/01/29

Content by: Evelyn Mikkelson

Search Term: PubMed: gastrointestinal leaks

Citation:

R. Medas and E. Rodrigues-Pinto, “Endoscopic treatment of upper gastrointestinal postsurgical leaks: a narrative review,” *Clin Endosc*, vol. 56, no. 6, pp. 693–705, Nov. 2023, doi: 10.5946/ce.2023.043.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC10665610/

Goals: Learn more about gastrointestinal leaks and treatment outside of Endovac.

Content:

Leaks

- Abnormal conditions between intraluminal and extraluminal caused by a problem with the gastrointestinal wall

Management

- Rescue surgery
- Watch and wait - followed by surgery if symptoms persist
- Interventional endoscopy newer approach
- Endoscopic surgery alone or with other surgery
- Performing surgery too late (after watch and wait strategy) associated with worse outcomes

Postsurgical Leaks

- Immediately after or weeks after
  - From technical issues
- Leak risk factors
  - Age, male gender, emergency surgery, smoking, alcohol abuse, BMI, malnutrition, anemia, blood loss, diabetes, hypertension, renal failure, cardiovascular disease, steroid use, calcification aorta or arteries

Diagnosis

- Asymptomatic from imaging --> sepsis/multi-organ failure
- Fever, abscesses
- Inspection surgical drains
- CT scans to inspect area
  - Combination CT and endoscopy as gold standard
- Delayed or absent spontaneous leak closure

    - Older age, malnutrition, high output drainage, cancer/tumor (radiation therapy, chemotherapy), immunosuppression, sepsis, diabetes, renal failure

Treatment

- Reestablish tract, infection/contamination control, drain fluid, provide nutrition
- Surgery
    - Depends on location and necrosis
    - Last option after failed/not able to do endoscopy or bad patient condition
    - Selection bias - sicker patients or those with failed procedures/therapies
- Endoscopy
    - Sutures, over the scope clips, fibrin glue, stents, drainage/drains, endoscopic vacuum therapy, septostomy
    - EVT - macroporous low density sponges, permeable films
        - Permeable films (open pore film drains) - perforated area is directly wrapped with film, easier to place (small diameter), less adherent (easier to remove
        - Combination of EVT with luminal stenting, only suitable intraluminal

Treatment Selection

- Stent placement remains most popular
    - Acute and small leaks
- EVT and stent good for oncologic
- EVT and EID (drainage) best after bariatric surgery
    - Acute and chronic leaks
    - EVT leaks greater than 2cm

Conclusions/action items:

This was a good overview of gastrointestinal leaks and treatment of them. I will continue to look into this topic to better understand why EVT isn't more widespread. I should also keep the permeable film in mind and see if it could be of use to the team.

REVIEW

Endoscopic treatment of upper gastrointestinal postsurgical leaks: a narrative review

Renato Marques[1], Eduardo Rodrigues-Pinto[1,2]

[1]Gastroenterology Department, Centro Hospitalar São João, Porto; [2]Faculty of Medicine of the University of Porto, Porto, Portugal

Upper gastrointestinal postsurgical leaks are life-threatening conditions with high mortality rates and are one of the most feared complications of surgery. Leaks are challenging to manage and often require radiological, endoscopic, or surgical intervention. Nearly all treatments in interventional endoscopy in recent decades have allowed the development of new endoscopic devices and techniques that provide a more effective and minimally invasive therapeutic option compared to surgery. Since there is no consensus regarding the most appropriate therapeutic approach for managing postsurgical leaks, this review aimed to summarize the best available current data. Our discussion specifically focuses on leak diagnosis, treatment aims, comparative endoscopic technique outcomes, and combined multidisciplinary approach efficacy.

Keywords: Anastomotic leak; Fistula; Surgery; Endoscopy; Esophagectomy; Gastrectomy; Upper gastrointestinal tract

INTRODUCTION

Leaks, perforations, and fistulas, though often used interchangeably, are different types of transmural defects and are associated with different endoscopic closure rates.[1] Most of the literature so far has evaluated the efficacy of endoscopic therapy for transmural defects in general rather than for leaks alone.[1]

Leaks are defined as direct and communications between the intraluminal and extraluminal compartments, usually owing to a defect in the integrity of the gastrointestinal wall. Upper gastrointestinal (UGI) postsurgical leaks (PSL) has increased in prevalence in recent years[2] and are the strongest independent risk factor for postoperative mortality.[3]

Received: June 28, 2023 Revised: March 28, 2024
Accepted: April 1, 2024

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E-mail: edu.gil.pinto@gmail.com

Management of PSL is often challenging and may require radiological, endoscopic, or surgical intervention.[1] Traditionally, either rescue surgery or a watch-and-wait strategy followed by surgery if symptoms persist have been the preferred therapeutic approaches. Recently, endoscopy has been emerging as a first-line therapeutic approach and is associated with lower mortality and better quality of life as opposed to surgery.[4] Timely advancements in interventional endoscopy in recent decades have allowed the development of new endoscopic devices and techniques that provide a more minimally invasive and effective therapeutic option for PSL than surgery. There are multiple endoscopic surgical options available which can be used as sole therapy or in combination with other surgical techniques.

Currently, there is no consensus regarding the most appropriate therapeutic approach for the management of PSL. Due to the continued widespread use of a watch-and-wait strategy in clinically stable patients, leaks are often referred late for endoscopic treatment. Late referral is unfortunately associated with worse endoscopic outcomes.[5] Even when diagnosed early, endoscopic management remains complex and often requires multiple endoscopic treatments spanning several months. In

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2026/01/29 Endoscopic Treatment Devices

Evelyn Mikkelson - Jan 29, 2026, 6:18 PM CST

Title: Technical Review on Endoscopic Treatment Devices for Management of Upper Gastrointestinal Postsurgical Leaks

Date: 2026/01/29

Content by: Evelyn Mikkelson

Search Term: PubMed: gastrointestinal leaks

Citation:

> R. Medas and E. Rodrigues-Pinto, “Technical Review on Endoscopic Treatment Devices for Management of Upper Gastrointestinal Postsurgical Leaks,” *Gastroenterol Res Pract*, vol. 2023, p. 9712555, 2023, doi: 10.1155/2023/9712555.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC10279499/

Goals: Learn more about other treatments of gastrointestinal leaks that could be competing designs.

Content:

Treatment

- Specific to patient considering variables that can influence outcome
- Factors
  - Patient stability
  - Time from surgery
- Stable patients in watch and wait leads to variable rates of spontaneous closure
- Rescue/redo surgery increase recurrence and mortality, cost also increases 10 fold
- No consensus on most appropriate therapeutic approach

Leaks

- Anatomic, physiologic factors and technical errors
- Blood supply and tension on anastomosis site essential

Stents

- Cylindrical devices to preserve or re-establish lumen
  - Seal leak and divert contents away from site
- Selection requires knowledge of technology, type, dimensions, leak location and feature
- Esophageal SEMS (self expanding metal stents)
  - Silicone coating (full or partial) can increase risk of displacement, can be hard to remove
  - SEPS (self expendable plastic stents) also tend to move and require more work so are less common
- Biodegradable stents
  - Degrade 6-24 weeks, faster with acidic environment
  - Difficulty with tissue response and weaker radial force

- High migration as major limitation
    - Bariatric stents (longer and larger) show same success with migration rate of traditional stents (not self expanding)

Over the Scope Clips

- Cap pulls in target tissue or tissue using vacuum suction
- Placement challenges in limited access, mobility, and alignment
- Hard to remove if put in wrong and makes repair difficult

Endoscopic Suturing

- OverStitch device - need to be familiar with device and activation
- Continuous placement of sutures without removing endoscope or reloading
- Not great results

Tissue Sealants

- Faster degradation when in contact with GI tract and infection is a concern
- Poor mechanical properties
- Variable success
- Usually used with other techniques

Cardiac Septal Defect Occluder

- Self expandable double disc closure device
- Promote occlusion and tissue ingrowth
- Employment via guidewire or catheter

Endoscopy Vacuum Therapy

- Foam sponge on suction tube
- During every endoscopic session sponge size needs to be changes to new size
    - Changed every 3-4 days to 1 week depending on application
- Limitations
    - Rescue application, location, long term nasal tube, multiple endoscopic sessions

Endoscopic Internal Drainage

- With pigtail plastic stents
- Drain fluid (reduction leak size) and foreign body reaction promoting closure
    - All in one procedure
- At end small cavity with to clinical repercussions
- Time interval undetermined

Endoscopic Septotomy

- Cutting septum between perigastric cavity and gastric cavity

Conclusions, action items:

This was a good overview of all the treatment options for gastric leaks. There are a few that could be utilized for competing devices, I will keep this in mind for the PDS.

Evelyn Mikkelson - Jan 29, 2026, 6:19 PM CST

Review Article

Technical Review on Endoscopic Treatment Devices for Management of Upper Gastrointestinal Postsurgical Leaks

Renato Medas and Eduardo Rodrigues-Pinto

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GRP2023-9712555.pdf (2.97 MB)

2026/02/03 Role of Endoscopic Vacuum Therapy

Evelyn Mikkelson - Feb 03, 2026, 5:18 PM CST

Title: Role of Endoscopic Vacuum Therapy in the Management of Gastrointestinal Transmural Defects

Date: 2026/02/03

Content by: Evelyn Mikkelson

Search Term: Google: endoscopic wound vac

Citation:

D. T. H. de Moura *et al.*, “Role of endoscopic vacuum therapy in the management of gastrointestinal transmural defects,” *World J Gastrointest Endosc*, vol. 11, no. 5, pp. 329–344, May 2019, doi: 10.4253/wjge.v11.i5.329.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC6556487/

Goals: Learn more about the mechanism of action of endovac.

Content:

EVT

- Promotes healing via macrodeformation, microdeformation, changes in perfusion, fluid management, clearing bacteria

Other Treatments

- Clips
- Cap mounted clips
- Self expandable metal stents
- Tissue sealants
- Endoscopic sutures

Macrodeformation

- Deformation force on edges of defect
- Pulls edges together
- Given negative pressure of 125mmHg, open pore polyurethane sponge reduce to 80% of volume, resulting in smaller defect

Microdeformation

- Mechanical changes on microscopic scale caused by suction
- Strain --> cytoskeleton --> growth factor initiation --> increase healing
- Affected by amount of suction, sponge properties (pore size, consistency), tissue being treated and the tissue around it

Changes in Perfusion

- Vacuum therapy increases microvessel density
    - External wound 300mmHg applied to sponge increases blood flow 5x

    - External wound 300mmHg applied to sponge increases blood flow 5x
    - Negative pressure 125mmHg increase vessel density

Fluid Management

- Buildup of fluid in/around tissue prevents healing by inhibiting nearby cells and tissues
- Removing fluid decreases compression on microvessels, allowing better blood flow and perfusion

Bacterial Clearance

- Unidentified role in vacuum therapy reducing bacterial contamination
    - Either increase or no change

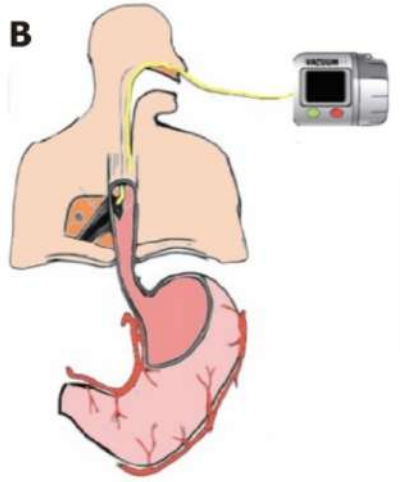
EVT Candidates and Use

- Typically used for larger defects
- Small defect (with contaminated cavity) requires dilation to access cavity to place sponge extraluminally
    - Less than 10mm (without cavity) intraluminal placement of sponge
- Control sepsis
    - Remove necrotic material and promote healing
    - Stabilize patient

EVT Procedure

- Standard sponge size 3-7cm long and 2-3cm diameter
- Some soak sponge with water soluble contrast to allow fluoroscopic assisted placement
- Passage through upper esophageal sphincter difficult due to size of all the instruments
- Endoscope to perforation site (small) or inside cavity (large)
    - Grasper places sponge while endoscope drawn back into lumen
    - Sponge can be adjusted with grasper for position

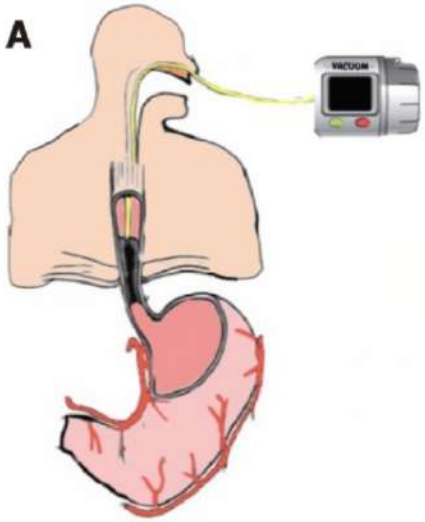
Intracavity Placement

- Short sponge placed extraluminal
    - Long sponge would fold in on itself
- Cavity drains, collapses into lumen, seals
- 

- Figure 1. Extraluminal placement of sponge.

Intraluminal Placement

- Sponge in GI lumen
- Long, cylinder sponge
- Lumen will collapse over defect
- Keeps tract dry to avoid contamination



- Figure 2. Intraluminal placement of sponge

Open Pore Polyurethane Sponge and Open Pore Film Drains

- Sponges are more commonly used
  - Only commercially available is Endosponge
  - No electronic pump system has been approved
- Films are newer and use thin open pore double layer drainage film
  - Suprasorb
  - Very small diameter
  - Adhere well to defect, less tightly to normal mucus surrounding it
- Double lumen drain with jejunal feeding tube allows nutritional support

Efficacy

- Upper GI Tract
  - Two studies of 10 patients had 100% success in 3-7 days
  - Esophageal acute perforations success rate 90%, changing sponge 5.4 times
  - Intrathoracic leaks efficacy 66.7%-100%
    - 2/5 100% without adverse event
  - 84.4% EVT closure vs 53.8% stent closure
    - Multiple studies showed EVT over stent
  - Largest series showed EVT over surgical revision, stent, conservative management
- Post Bariatric
  - Multiple studies show 100% resolution of leaks
    - One report case of EVT failing to heal staple line leaks
- Small Bowl and Pancreas/Gallbladder Defects
  - Reported successful
  - Pancreatic use EVT is one of many steps, favorable results but high risk
    - Massive hemorrhage in celiac trunk and portal venous system
    - EVT as rescue therapy

    - Biliopancreatic surgery EVY using long sponge in stomach shows success
- Lower GI
    - Variable effects for all treatment options
    - EVT not as standardized for this use but gaining popularity with multiple successful studies
    - Concern of feces blocking vacuum
        - Use with fecal diversions

Safety

- Common complaint of patients is NG tube causing patient discomfort
    - Especially patients with additional nasoenteral tube
- Distress caused by repeat procedures for sponge exchange
- Adverse events
    - Sponge dislocation
    - Minor bleeding after exchange (granulation tissue grown on sponge)
    - Narrowing of tract
        - Severe bleeding after attempts to dilate
    - Major bleeding has been reported (hemorrhage)
- If significant bleed EVT should be stopped and CT performed
    - CT before EVT to avoid vascular tissue

Conclusions, action items:

This was a really good overview of how EVT promotes healing, how it works, and how it can go wrong. Next I will be diving into more PDS relevant material.

Evelyn Mikkelson - Feb 03, 2026, 5:19 PM CST

Download

WJGE-11-329.pdf (3.2 MB)

2026/02/03 Anatomy of Esophagus and Sphincters

Evelyn Mikkelson - Feb 03, 2026, 6:15 PM CST

Title: Esophageal Stricture

Date: 2026/02/03

Content by: Evelyn Mikkelson

Search Term: Google: diameter ues

Citation:

> "Fig. 1. Measurement of maximum upper esophageal sphincter (UES) opening...," ResearchGate. Accessed: Feb. 03, 2026. [Online]. Available: https://www.researchgate.net/figure/Measurement-of-maximum-upper-esophageal-sphincter-UES-opening-diameter-and-UES-nadir_fig1_221821634

Link: https://www.researchgate.net/figure/Measurement-of-maximum-upper-esophageal-sphincter-UES-opening-diameter-and-UES-nadir_fig1_221821634

Goals: Get the diameter of the upper esophageal sphincter for use in PDS.

Content:

Normal diameter is 10-14mm

- Larger than normal > 15mm
- Smaller than normal < 10mm

Conclusions, action items:

Put this into PDS and research other patient considerations.

Evelyn Mikkelson - Feb 03, 2026, 6:16 PM CST

Innovative Methodology

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Upper esophageal sphincter impedance as a marker of sphincter opening diameter

Download

Omari_AJP_2012.pdf (946 kB)

2026/02/25 Diagnosis and Management Anastomotic Leaks

Evelyn Mikkelson - Feb 25, 2026, 6:41 PM CST

Title: Diagnosis and Management of Anastomotic Leaks After Ivor Lewis Esophagectomy

Date: 2026/02/25

Content by: Evelyn Mikkelson

Search Term: Google: diagnosis anastomotic leaks esophagus

Citation:

A. R. Latorre-Rodríguez *et al.*, “Diagnosis and management of anastomotic leaks after Ivor Lewis esophagectomy: a single-center experience,” *Langenbecks Arch Surg*, vol. 408, no. 1, p. 397, Oct. 2023, doi: 10.1007/s00423-023-03121-x.

Link: https://link.springer.com/article/10.1007/s00423-023-03121-x

Goals: Learn more about anastomotic leaks in relation to esophagectomies.

Content:

Esophageal Anastomotic Leaks

- Discontinuity in anastomosis, staple lines, or walls of the esophagus
- Serious complication after esophagectomy
- Risk varies by location anastomosis
- Risk factors: male, obese, smoking, hypertension, vascular/coronary disease, diabetes, chronic renal disease, obstructive pulmonary disease, medications, previous surgery/therapy

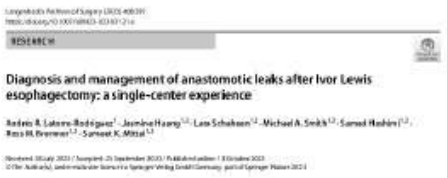
Diagnosis and Management

- Range of symptom severity
  - Asymptomatic -> very symptomatic -> sepsis
- Management depends on how bad it is
  - Prevent sepsis, nutrition, fix defect
- Diagnose by imaging, symptoms, end0scopy
  - Leukocytosis, elevated serum procalcitonin could also be from inflammatory response
- Timely and accurate diagnosis is critical

Conclusions, action items:

Keep this in mind for use in the preliminary report.

Evelyn Mikkelson - Feb 25, 2026, 6:41 PM CST



RESEARCH

Diagnosis and management of anastomotic leaks after Ivor Lewis esophagectomy: a single-center experience

Abstract

Purpose Esophageal anastomotic leaks (ALs) after esophagectomy are a common and serious complication. The incidence, diagnostic approach, and management have changed over time. We described the diagnosis and management of patients who developed an esophageal AL after an Ivor Lewis esophagectomy at our center.

Methods After IRB approval, we queried our prospectively maintained database for patients who developed an esophageal AL after esophagectomy from August 2016 through July 2022. Data pertaining to demographics, comorbidities, surgical and oncological characteristics, and clinical course were extracted and analyzed.

Results During the study period, 145 patients underwent an Ivor Lewis esophagectomy. Overall 9% developed an AL, diagnosed a median of 7.5 days after surgery, and classified by enteric contents: at wound drains (n = 7), endoscopy (n = 3), CT (n = 2), and contrast esophagogram (n = 2). Nine patients (90%) had an increasing white blood cell count and additional signs of sepsis. One asymptomatic patient was identified by contrast esophagography. All patients received enteral nutritional support, remained npo and n/v/c, and antifungals. Primary treatment of AL included endoscopic placement of uncT expanding metal stent (SEMS, n = 6), surgery (n = 2), and SEMS + tx (subdiaphragmal vac-assist therapy (n = 2). One patient required surgery after SEMS placement. The median length of ICU and total hospital stays were 11.5 and 22.5 days, respectively. There was no 30-day mortality.

Conclusion The incidence of esophageal ALs at our center is similar to that of other high-volume centers. Most ALs can be managed without surgery; however, ALs remain a significant source of perioperative morbidity despite clinical advancements that have improved mortality.

Keywords Esophagectomy · Esophageal surgery · Anastomotic leaks

Introduction

Esophageal anastomotic leaks (ALs) are a discontinuity in the anastomosis, staple lines, or conduits of the esophagus [1]. They are one of the most serious complications after esophagectomy and can lead to prolonged hospital stays and high mortality rates [2]. The incidence of ALs differ between centers; for experienced high-quality programs, it ranges from 5 to 20% [3]. The incidence also varies by the anatomical location of the anastomosis; it is almost 4.7 times higher in the cervical region than in the intrathoracic region [4]. Esophageal ALs are the third most common complications of esophagectomy, after pulmonary infections and supraventricular arrhythmias [5]. The mortality rate among patients who develop an esophageal AL is more than double that of those who do not (7.3% vs. 3.1%) [6].

The cause of an esophageal AL cannot usually be established and is multifactorial; however, several studies have identified risk factors: male sex, obesity, history of smoking, hypertension, vascular and coronary diseases, diabetes mellitus type 2, chronic renal disease, chronic obstructive pulmonary disease, some medications (i.e., steroids, NSAIDs, or beta-blockers), previous abdominal surgery, and thoracic radiotherapy [2, 4, 7].

Steven K. Mittal
[redacted]

Virginia Piper Cancer Institute, St. Joseph's Hospital and Medical Center, 8301W Thomas Road, Phoenix, AZ 85013, USA

Creighton University School of Medicine, Phoenix Regional Campus, Phoenix, AZ, USA

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s00423-023-03121-x.pdf (1.26 MB)

2026/02/25 Anastomotic Leak After Esophagectomy

Evelyn Mikkelson - Feb 25, 2026, 7:14 PM CST

Title: Management of Anastomotic Leaks After Esophagectomy and Gastric Pull Up

Date: 2026/02/25

Content by: Evelyn Mikkelson

Search Term: Google: anastomotic leaks in esophagus

Citation:

A. Famiglietti *et al.*, “Management of anastomotic leaks after esophagectomy and gastric pull-up,” *J Thorac Dis*, vol. 12, no. 3, pp. 1022–1030, Mar. 2020, doi: 10.21037/jtd.2020.01.15.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC7139088/

Goals: Learn more about anastomotic leaks in esophagus.

Content:

Esophagectomy with Gastric Pull Up

- Treatment esophageal cancer
- Benign esophageal disease
- Esophageal rupture
- High morbidity and mortality
- Leak at anastomosis common complication

Non Operative

- Ending oral diet and antibiotics
- Drain in neck or chest

Stent

- Widely used
- Success in closure and maintain ability to eat
- Dependent on size of defect and control of area
    - Use with drainage and antibiotics
- Biodegradable, metal, plastic

EVAC

- Negative pressure via NG tube attached to sponge
- Sponge changed every few days
- Mortality rates do not differ but closure rates do
- Combination stent and sponge

Clips and Suturing

- OverStitch - suture

- OverStitch - suture
    - Lack of longevity
- OTSCs - clips
    - Close larger defects than those deployed through endoscope channel
    - Limited trials

Novel Approaches

- AlloDerm patch
    - Human acellular dermis
    - Cellular regeneration
- Chimera stent
    - Prevent upstream gastric reflux
    - Diameter wide enough to adhere to gastric wall

Conclusions, action items:

Use this for the preliminary report.

Evelyn Mikkelson - Feb 25, 2026, 7:14 PM CST

Management of anastomotic leaks after esophagectomy and gastric pull-up

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jtd-12-03-1022.pdf (1.43 MB)

2026/02/26 Inflammation and pH, Temperature

Evelyn Mikkelson - Feb 26, 2026, 12:40 PM CST

Title: The Effect of Inflammation Management on pH, Temperature, and Bacterial Burden

Date: 2026/02/26

Content by: Evelyn Mikkelson

Search Term: Google: pH and temperature changes in infected area

Citation:

R. Derwin, D. Patton, H. Strapp, and Z. Moore, “The effect of inflammation management on pH, temperature, and bacterial burden,” *Int Wound J*, vol. 20, no. 4, pp. 1118–1129, Oct. 2022, doi: 10.1111/iwj.13970.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC10031221/

Goals: Research the infection conditions present in the anastomosis so we can tailor degradation to it.

Content:

Wound Healing

- TIME = Tissue, Inflammation/Infection, Moisture imbalance, Epithelial edge

pH

- Baseline 7.90-8.70
  - From 108 observations
  - Most pH above 8 at baseline
  - Lower than 8 - one almost healed, one necrotic
  - With healing and re-epithelialization, return to acidic
- Slowly decreasing (alkaline) pH until wound almost closed (return to acidic)
- Lower pH indication of harmful bacteria
- Bacterial reduction reduces ammonia and will lower pH
  - 8.30 or above with harmful bacteria
  - 6.5 or below bacteria not present

Temperature

- Decreased with wound size
- Increased with infection
- Difference in temperature from edges to center
- Wide variation from internal and external factors
- Mean wound temp 32.55deg C
  - Cooler on lower extremities
  - Limbs lower temperature than core

Conclusions, action items:

This was a good look at external infections. I feel like I should find an article about internal response, especially for temperature.

Evelyn Mikkelson - Feb 26, 2026, 12:40 PM CST

ORIGINAL ARTICLE

IWJ WILEY

The effect of inflammation management on pH, temperature, and bacterial burden

Rosemarie Derwin[1] | Declan Patton[1,2] | Helen Strapp[3] | Zena Moore[1,4,5,6,7,8,9]

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Email: rosemariederwin@rcsi.ie

Funding information
Irish Research Council, Enterprise

Abstract

The aim of this feasibility study was to investigate the impact of inflammation management on wound pH, temperature, and bacterial burden, using the principles of TIME and Wound Bed Preparation. A quantitative non-comparative, prospective, descriptive observational design. Following ethical approval, 20 participants with 27 wounds of varying aetiologies were observed twice weekly for 2 weeks. Wounds were treated with cleansing, topical sharp debridement, and topical cadexomer iodine. Wound pH (pH indicator strips), temperature (infrared camera), bacterial burden (fluorescence imaging) and size (ruler method) was monitored at each visit. The mean age of all participants was 47 years (SD: 20.3 years), and 70% (n = 19) were male, and most wounds were acute (70%; n = 19) and included surgical and trauma wounds. The remaining (30%; n = 8) were chronic and included vascular ulcers and non-healing surgical wounds. Mean wound duration was 33.06 days (SD: 64.40 days). Over the follow up period, pH values ranged from 6 to 8.7, temperature (centre spot) ranged from 28.4°C to 36.4°C and there was an average 39% reduction in wound size. Inflammation management had a positive effect on pH, temperature, bacterial burden, and wound size. This study demonstrated that it was feasible to practice inflammation management using a structured approach to enhance wound outcomes.

KEYWORDS
MolecuLight, pain, wound assessment, wound pH, wound temperature

Key Messages

- wound assessment incorporating objective measures such as pH and temperature measurement is valuable in monitoring the wound status
- the MolecuLight i:X fluorescence imaging device can also be used to assess and to guide appropriate treatment

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IWJ-20-1118.pdf (4.77 MB)

2026/02/26 pH Monitoring Anastomotic Leak

Evelyn Mikkelson - Feb 26, 2026, 2:32 PM CST

Title: The Effect of Inflammation Management on pH, Temperature, and Bacterial Burden

Date: 2026/02/26

Content by: Evelyn Mikkelson

Search Term: Google: esophagus leak temperature and pH

Citation:

> M. Huynh, R. Tjandra, N. Helwa, M. Okasha, A. El-Falou, and Y. Helwa, “Continuous pH monitoring using a sensor for the early detection of anastomotic leaks,” *Front Med Technol*, vol. 5, p. 1128460, May 2023, doi: 10.3389/fmedt.2023.1128460.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC10235488/

Goals: Learn more about change in pH associated with anastomotic leaks to tune degradation.

Content:

pH Sensor

- Polyaniline (PANI) based pH sensor connected to surgical drains
  - pH sensitive polymer
  - Ag/AgCl reference
- Monitoring peritoneal secretion
- Attaches to surgical drains between catheter and evacuator

Postoperative Clinical Biomarkers

- Serum and peritoneal drain fluid
- pH, lactate, interleukin 6 (IL-6), interleukin 10 (IL-10), tumor necrosis factor alpha (TNFa)
  - pH is quick, easy, inexpensive to measure
- Decrease in pH drainage fluid

Procedure

- Baseline pH 7.80 and 7.76
- Leaks as sharp increase or decrease in pH measurement

Anastomotic Leaks

- Significant morbidity and mortality
- Potential reoperation
- Additional diagnostic tests
- Extended hospital stay
- Increase $30,885 hospital expenses to paitent
- Increase $28.6 million per 1,000 patients for involved hospitals

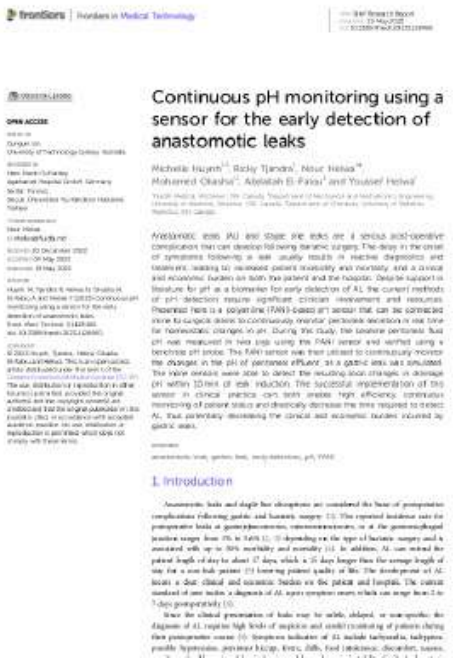
pH Measurements

- Peritoneal fluid significant buffer capacity, 7.5-8 in humans
- Linked to ischemia in AL (anerobic metabolism) that decreases pH
- Inflammation response reduces local pH

Conclusions, action items:

This is a good start. I was doing this before biomaterial lecture and think I should potentially look into impregnating the sponge with something instead of a coating (Nitinol). Will continue to look.

Evelyn Mikkelson - Feb 26, 2026, 2:33 PM CST



Continuous pH monitoring using a sensor for the early detection of anastomotic leaks

1. Introduction

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fmedt-05-1128460.pdf (2.02 MB)

2026/01/29 OverStitch Endoscopic Suturing

Evelyn Mikkelson - Feb 03, 2026, 3:57 PM CST

Title: OverStitch Endoscopic Suturing System

Date: 2026/01/29

Content by: Evelyn Mikkelson

Search Term: Google: OverStitch

Citation:

> "OverStitch™ Endoscopic Suturing System," www.bostonscientific.com. Accessed: Jan. 29, 2026. [Online]. Available: https://www.bostonscientific.com/en-US/products/endoscopic-closure/overstitch-endoscopic-suturing-system.html

Link: https://www.bostonscientific.com/en-US/products/endoscopic-closure/overstitch-endoscopic-suturing-system.html

Goals: Learn more about this device that was mentioned in the last paper I read.

Content:

Overview

- Place full thickness sutures
- Minimally invasive
- Customize patterns

Features

- Curved needle to control depth
- Cinch (knotless closure)

Conclusions/action items:

This is a cool solution for suturing endoscopically. This can be used in competing devices in the PDS

Evelyn Mikkelson - Jan 29, 2026, 6:28 PM CST


Product Details

Download

OverStitch.pdf (494 kB)

2026/02/03 Eso-SPONGE

Evelyn Mikkelson - Feb 03, 2026, 4:06 PM CST

Title: Eso-SPONGE

Date: 2026/02/03

Content by: Evelyn Mikkelson

Search Term: Google: esosponge

Citation:

> “Eso-SPONGE Endoluminal Vacuum Therapy,” www.bostonscientific.com. Accessed: Feb. 03, 2026. [Online]. Available: https://www.bostonscientific.com/en-EU/products/endoluminal-vacuum-therapy/eso-sponge.html

Link: https://www.bostonscientific.com/en-EU/products/endoluminal-vacuum-therapy/eso-sponge.html

Goals: Learn more about the applications and use of this device, as it was mentioned by the team in our advisor meeting.

Content:

Use

- Prevent and treat anastomotic leaks, perforations
- Only if endoscopically accessible (within range overtube)

Sponge

- Hydrogel impregnated

Success

- Successful treatment 84% of patients
- Likely superior to stent treatment
- Promotes granulation tissue ingrowth
- Can be combined with stent depending on situation

Conclusions/action items:

This was a good overview of Eso-SPONGE. Next I will be looking at articles relevant to the PDS.

Evelyn Mikkelson - Feb 03, 2026, 4:07 PM CST

Download

Eso-SPONGE.pdf (754 kB)

2026/02/04 Suprasorb CNP Drainage Film

Evelyn Mikkelson - Feb 04, 2026, 11:36 AM CST

Title: Suprasorb CNP Drainage Film

Date: 2026/02/04

Content by: Evelyn Mikkelson

Search Term: Google: Suprasorb CNP Drainage Film

Citation:

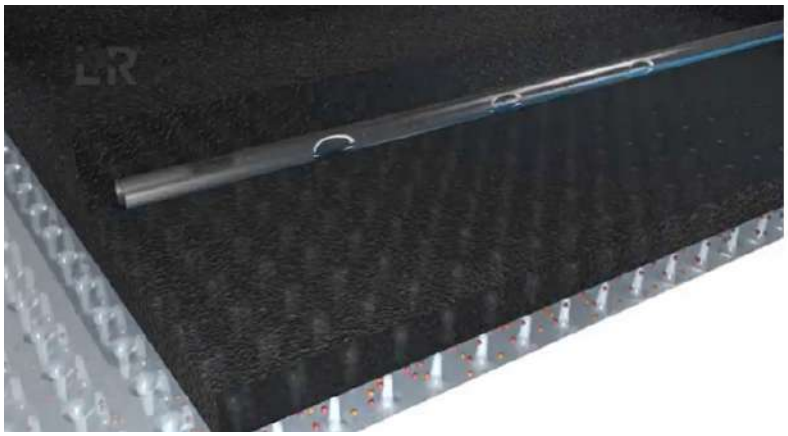
> “L&R AE: Suprasorb CNP Drainage Film.” Accessed: Feb. 04, 2026. [Online]. Available: https://www.lohmann-rauscher.com/ae-en/products/suprasorb-cnp/suprasorb-cnp-drainage-film/

Link: https://www.lohmann-rauscher.com/ae-en/products/suprasorb-cnp/suprasorb-cnp-drainage-film/

Goals: Learn more about this film that was mentioned in a previous article as a sponge alternative.

Content:

Material

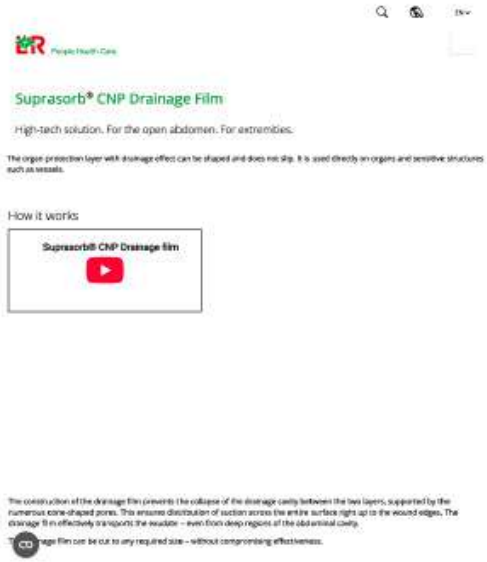
- 
- Figure 2. Image from video showing use with a suction tube. It appears to still require a sponge.
- Can be cut to size without effecting structure

Use

- Open abdomen, external, protection, drainage

Conclusions/action items:

This film should be kept in mind as we go through the design process. From the articles I have read it seems film can be utilized for longer intervals and had less ingrowth.



Download

Suprasorb.pdf (341 kB)

2026/02/11 VACStent

Title: VACStent: Combining the Benefits of Endoscopic Vacuum Therapy and Covered Stents for Upper Gastrointestinal Tract Leakage

Date: 2026/02/11

Content by: Evelyn Mikkelson

Search Term: Google: endovac stent

Citation:

J. Lange, A. Dormann, D. Bulian, U. Hügle, C. Eisenberger, and M. Heiss, “VACStent: Combining the benefits of endoscopic vacuum therapy and covere tract leakage,” *Endoscopy International Open*, vol. 09, pp. E971–E976, May 2021, doi: 10.1055/a-1474-9932.

Link: https://www.researchgate.net/publication/351929040_VACStent_Combining_the_benefits_of_endoscopic_vacuum_therapy_and_covered_stents_for

Goals: Learn more about this stent sponge combo used for EndoVAC.

Content:

VACStent

- Combines fully covered SEMS with sponge on outside
- Prevent stent movement because suction
- Allows passage for fluids and nutrition

Methods

Figure 1. Structure of the VACStent showing the core nitinol stent in a silicone membrane and the polyurethane sponge surrounding it.

- When negative pressure applied only flared ends in contact with intestinal wall (seal)
- Sponge 50mm long, inside diameter 12mm
- Stent 30mm diameter

Figure 2. Application of the VACStent though a 12mm diameter introducer. It is inserted through the mouth using an over the wire technique.

- Grabbing the flared end with forceps and pulling to move reduces stent diameter, also used to remove device
- Pressure 80mmHg - 120mmHg, VACStent will stay in place down to 50mmHg

Results

- Still needs to be removed/replaced every 3-7 days because of ingrowth

Conclusions/action items:

This is a good device that mimics what we are trying to design. I am going to look more at how the SEMS work and other possibilities for expansion after ins

Evelyn Mikkelson - Feb 11, 2026, 5:21 PM CST

VACStent: Combining the benefits of endoscopic vacuum therapy and covered stents for upper gastrointestinal tract leakage

OPEN ACCESS

Download

VACStent_Combining_the_benefits_of_endoscopic_vacu.pdf (843 kB)

2026/02/11 Metal Stent Development

Evelyn Mikkelson - Feb 11, 2026, 5:53 PM CST

Title: Basic Knowledge about Metal Stent Development

Date: 2026/02/11

Content by: Evelyn Mikkelson

Search Term: Google: how do self expanding metal stents work

Citation:

S. Jeong, “Basic Knowledge about Metal Stent Development,” *Clin Endosc*, vol. 49, no. 2, pp. 108–112, Mar. 2016, doi: 10.5946/ce.2016.029.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC4821512/#:~:text=Wire,open%20cell%20type%20of%20stent.

Goals: Learn more about self expanding stents.

Content:

Wire

- Gives elasticity and flexibility
- Stainless steel or nickel titanium (nitinol) alloys
  - Nitinol has shape memory, can be smaller diameter and delivered by catheter to bile duct to expand under body temperature
- Wire braided in crossover pattern or laser cut
  - Two layers crossover with or without membrane also an option
  - Braided is more closed cell and can resist ingrowth
  - Laser cut is open cell, but better for shortening and proper positioning

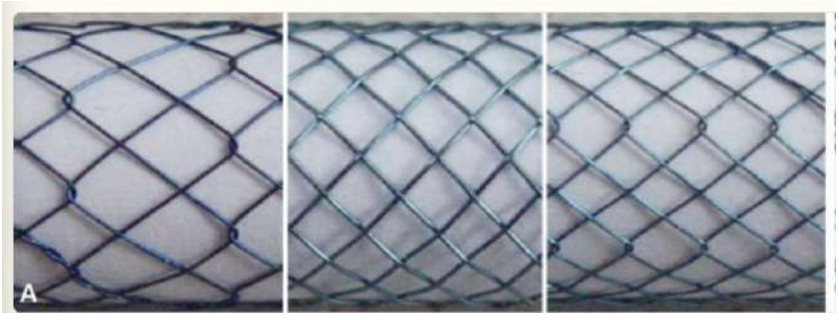


Figure 1. Variations of wire crossover patterns.

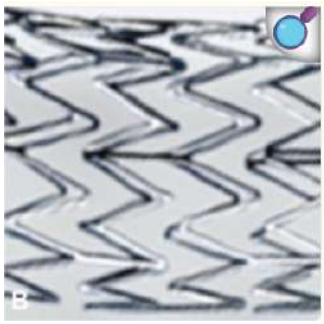


Figure 2. Laser cut structure of a stent.

- Cell Size
  - Controlled in wire weaving method
  - No definite evidence that ingrowth increases with cell size

Membrane

- In biliary SEMS: polyurethane, silicone, polytetrafluoroethylene
- Has been used to prevent ingrowth
- Strength of covering and developed cracks can effect function
  - Consideration for growth of biofilm

Radiopaque Markers

- Improve placement and monitor expansion and movement

Mechanical Properties

- Radial force, axial force, flexibility, shortening ratio, radiopacity, and trackability
- Radial force allows expansion
  - Wire diameter, cell size, method of making (braided, laser cut)
- Biliary stents require low axial force and high radial force

Structures

- Anti reflux valves in duodenal
- Drug eluting membranes for controlled release of drugs
- Specially braided, double layered to prevent ingrowth
- Anchors to prevent movement
- Segmenting with different cell sizes over the length

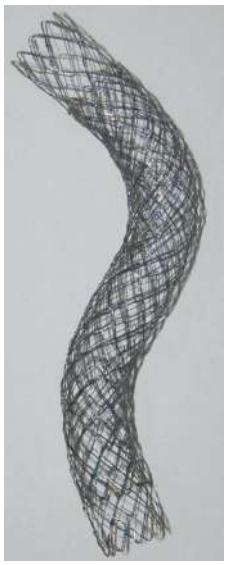


Figure 3. Double layer structure with small cell size.

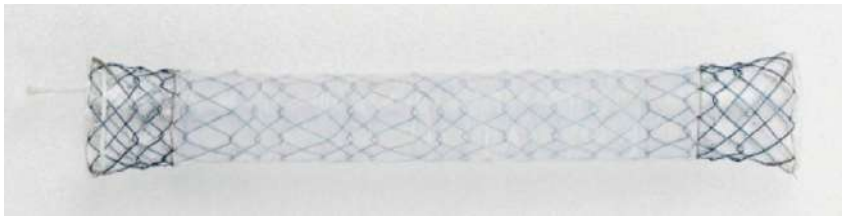


Figure 4. Covered stent with different cell sizes that creates segmentation.

Conclusions/action items:

This is really good information when thinking about design ideas. I am going to look into more possibilities that would allow expansion of the sponge after deployment

Evelyn Mikkelson - Feb 11, 2026, 5:54 PM CST

FOCUSED REVIEW SERIES

Basic Knowledge about Metal Stent Development

INTRODUCTION

BASIC STRUCTURE OF SEMS

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ce-2016-029.pdf (1.59 MB)

2026/02/11 Padlock Clip Defect Closure System

Evelyn Mikkelson - Feb 11, 2026, 6:39 PM CST

Title: Padlock Clip Defect Closure System

Date: 2026/02/11

Content by: Evelyn Mikkelson

Search Term: Google: endoscopy accessories

Citation:

"Padlock Clip Defect Closure System | STERIS," *Steris.com*, 2017. https://www.steris.com/healthcare/products/endoscopy-devices/gi-bleed-management-and-irrigation/padlock-clip-defect-closure-system#ShopNow (accessed Feb. 12, 2026).

Link: https://www.steris.com/healthcare/products/endoscopy-devices/gi-bleed-management-and-irrigation/padlock-clip-defect-closure-system#ShopNow.

Goals: Look into this device to secure sponge.

Content:

How it Works

- Clip for full circumferential tissue closure
  - Lift, close, promote healing
- Closure perforations less than 20mm
- Over the scope
- Deploys by push of thumb
- Lays flat against tissue
- Controllers on prong limit penetration depth

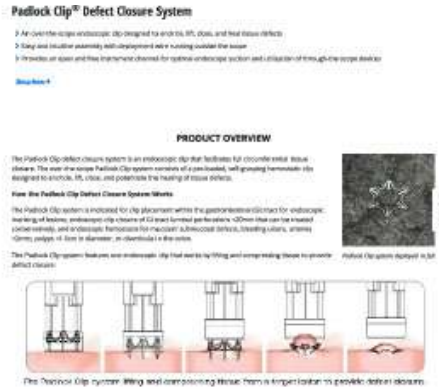
Removal

- Can pass naturally after healing of defect (one month - two years)
- Not intended to be removed once placed

Conclusions/action items:

I feel like something like this could be utilized to hold sponge in place, but we would have to find a way to make it removable or degradable. I will put a design together.

Evelyn Mikkelson - Feb 11, 2026, 6:40 PM CST


Padlock Clip® Defect Closure System

PRODUCT OVERVIEW

[Download](#)

PadlockClip.pdf (2.16 MB)

2026/02/25 V.A.C. GranuFoam Dressing Kits

Evelyn Mikkelson - Feb 25, 2026, 6:20 PM CST

Title: V.A.C. GranuFoam Dressing Kits

Date: 2026/02/25

Content by: Evelyn Mikkelson

Search Term: Link from client

Citation:

> “V.A.C. GranuFoam Dressing Kits | Medline.” Accessed: Feb. 24, 2026. [Online]. Available: https://www.medline.com/product/VAC-GranuFoam-Dressing-Kits/Z05-PF93193

Link: https://www.medline.com/product/VAC-GranuFoam-Dressing-Kits/Z05-PF93193

Goals: Look into the sponge/set up the client is currently using.

Content:

Design

- Flexible to accommodate different sizes and shapes of wounds

Use

- Wide variety of wounds
- Promote formation granulation tissue

Sponge

- Open pore (400-600 microns)
  - Uniform distribution pressure
- Hydrophobic for material removal

Conclusions/action items:

Put this information into the preliminary report for the materials section.

Evelyn Mikkelson - Feb 25, 2026, 6:20 PM CST

Download

GranuFoam.pdf (171 kB)

2026/02/27 GelFoam

Evelyn Mikkelson - Feb 27, 2026, 6:39 PM CST

Title: GelFoam

Date: 2026/02/27

Content by: Evelyn Mikkelson

Search Term: Google: GelFoam

Citation:

> “Gelfoam.” Pfizer Hospital, May 2022. [Online]. Available: https://labeling.pfizer.com/ShowLabeling.aspx?format=PDF&id=573

Link: https://labeling.pfizer.com/ShowLabeling.aspx?format=PDF&id=573

Goals: Look at this gelatin compressed sponge currently on the market.

Content:

Description

- Water insoluble, off white, nonelastic, porous
- From porcine skin
- Gelatin granules and water for injection
- Cut without fraying

Actions

- When not in excessive amounts, absorbed completely
- Soft tissues absorbed in 4-6 weeks
    - Nasal, rectal, vaginal liquefies in 2-5days

Clinical Studies

- Absorptive capacity 45 times its weight of whole blood
- Absorptive capacity function of physical size
    - Size increases as gelatin sponge increases

Animal Pharmacology

- Kidneys - assisted in healing, no inflammatory or foreign body reactions
- Liver resections - protective cover and structural support
- Rat muscle - no tissue reaction

Indications

- Used dry or saturated with sterile sodium chloride solution

Directions for Use

- Use minimum amount to produce hemostasis
- First application to control bleeding
    - If not repeat with new sterile sponge
- Dry
    - Apply to bleeding site and hold with moderate pressure
- Wet
    - Immerse sponge in sterile saline or thrombin
    - Remove from solution and squeeze to remove air
        - Should return to original size with slight expansion in solution
    - Remove and knead air out
    - Return to solution to ensure it expands to original size, with slight increases in thickness and shape
    - Apply to bleeding site
- Notes
    - Not necessary to apply suction, sponge capillary action
    - May be left at site until it liquifies

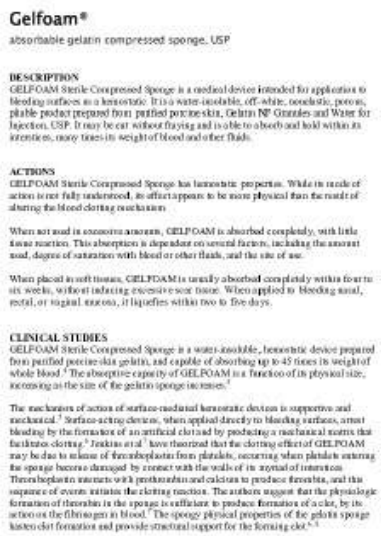
Warnings

- Not used in the presence of infection
- Not used for packing cavity unless excess is removed

Conclusions/action items:

I am still not sure what triggers this to expand, but I think gelatin/collagen is something I should continue looking into.

Evelyn Mikkelson - Feb 27, 2026, 6:39 PM CST



Gelfoam®

absorbable gelatin compressed sponge, USP

DESCRIPTION

GELFOAM Sterile Compressed Sponge is a medical device intended for application to bleeding surfaces as a hemostatic. It is a water-insoluble, off-white, nonelastic, porous, pliable product prepared from purified porcine skin, Gelatin NF Granules and Water for Injection, USP. It may be cut without fraying and is able to absorb and hold within its interstices, many times its weight of blood and other fluids.

ACTIONS

GELFOAM Sterile Compressed Sponge has hemostatic properties. While its mode of action is not fully understood, its effect appears to be more physical than the result of altering the blood clotting mechanism.

When not used in excessive amounts, GELFOAM is absorbed completely, with little tissue reaction. This absorption is dependent on several factors, including the amount used, degree of saturation with blood or other fluids, and the site of use.

When placed in soft tissues, GELFOAM is usually absorbed completely within four to six weeks, without inducing excessive scar tissue. When applied to bleeding nasal, rectal, or vaginal mucosa, it liquefies within two to five days.

CLINICAL STUDIES

GELFOAM Sterile Compressed Sponge is a water-insoluble, hemostatic device prepared from purified porcine skin gelatin, and capable of absorbing up to 45 times its weight of whole blood.[1] The absorptive capacity of GELFOAM is a function of its physical size, increasing as the size of the gelatin sponge increases.[1]

The mechanism of action of surface-mediated hemostatic devices is supportive and mechanical.[2] Surface-acting devices, when applied directly to bleeding surfaces, arrest bleeding by the formation of an artificial clot aid by producing a mechanical matrix that facilitates clotting.[3] Jenkins et al.[1] have theorized that the clotting effect of GELFOAM may be due to release of thromboplastin from platelets, occurring when platelets entering the sponge become damaged by contact with the walls of its myriad of interstices. Thromboplastin interacts with prothrombin and calcium to produce thrombin, and this sequence of events initiates the clotting reaction. The authors suggest that the physiologic formation of thrombin in the sponge is sufficient to produce formation of a clot, by its action on the fibrinogen in blood.[1] The spongy physical properties of the gelatin sponge hasten clot formation and provide structural support for the forming clot.[4, 5]

Download

USPI_-_Gelfoam_Compressed_Sponge_-_Absorbable_Gelatin.PDF (270 kB)

2026/01/24 Endovac Therapy

Evelyn Mikkelson - Jan 24, 2026, 11:24 AM CST

Title: Endoluminal Vacuum Therapy: How I Do It

Date: 2026/01/24

Content by: Evelyn Mikkelson

Search Term: Project description page: relevant journal articles and websites

Citation:

S. G. Leeds, M. Mencio, E. Ontiveros, and M. A. Ward, “Endoluminal Vacuum Therapy: How I Do It,” *J Gastrointest Surg*, vol. 23, no. 5, pp. 1037–1043, May 2019, doi: 10.1007/s11605-018-04082-z.

Link: https://pubmed.ncbi.nlm.nih.gov/30671790/

Goals: Start research for this project with the links provided by the client.

Content:

Problem

- Perforations and leaks in GI tract
- Endoscopic treatment have varying success

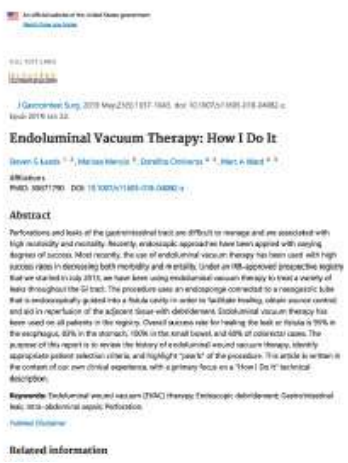
Endoluminal Vacuum Therapy

- High success
- Treats multiple types of leaks throughout tract
- Endosponge connected to nasogastric tube guided into fistula
    - Healing, control leak, reperfusion of tissue with debridement

Conclusions/action items:

This is a good start and I will continue to the other links provided.

Evelyn Mikkelson - Jan 24, 2026, 11:25 AM CST



Endoluminal Vacuum Therapy: How I Do It

Abstract

Related information

Download

Endovac_-_How_I_Do_It.pdf (190 kB)

2026/01/24 Endovac Instructional Video

Evelyn Mikkelson - Jan 24, 2026, 11:40 AM CST

Title: Endovac Instructional Video for Esophageal Perforation

Date: 2026/01/24

Content by: Evelyn Mikkelson

Search Term: Project description page: relevant journal articles and websites

Citation:

> Abubaker Ali, MD, FACS, *Endovac Instructional Video for esophageal perforation*, (Jun. 13, 2021). Accessed: Jan. 24, 2026. [Online Video]. Available: https://www.youtube.com/watch?v=ACIPkSugn7g

Link: https://youtu.be/ACIPkSugn7g?si=AHGZ2DHLG1ibTp11

Goals: Start research for this project with the links provided by the client.

Content:

Supplies

- Needle drive
- 2-0 prolene
- Suture Scissors
- 14 french ng tube
- Small black sponge that comes in vac kit

Diagnostic Endoscopy

- Size of perforation cavity
- Create appropriate size sponge - use scope to measure cavity
- Before placing sponge need to thread ng tube through nose and out of mouth
    - Manual or endoscope

Endovac Sponge

- Cut tip off ng tube and make sure holes (in ng tubes) are bring covered by sponge
- Roll sponge around tube and use 2-0 proline to "sew" sponge on tube through holes
    - Make sure tip of tube is not poking out
    - Last suture with small loop to move sponge with biopsy forceps to perforation

Conclusions/action items:

I have a better grasp now of the preparations that go into the endovac surgery and how it works. I will now move to the last link.

2026/01/24 Endovac in Management of Leaks and Perforations

Evelyn Mikkelson - Jan 24, 2026, 12:27 PM CST

Title: The use of Endoluminal Vacuum Therapy in the Management of Upper Gastrointestinal Leaks and Perforations

Date: 2026/01/24

Content by: Evelyn Mikkelson

Search Term: Project description page: relevant journal articles and websites

Citation:

> N. R. Smallwood, J. W. Fleshman, S. G. Leeds, and J. S. Burdick, “The use of endoluminal vacuum (E-Vac) therapy in the management of upper gastrointestinal leaks and perforations,” *Surg Endosc*, vol. 30, no. 6, pp. 2473–2480, Jun. 2016, doi: 10.1007/s00464-015-4501-6.

Link: https://www.medovate.co.uk/wp-content/uploads/2022/04/EVT009-Smallwood-2016.pdf

Goals: Start research for this project with the links provided by the client.

Content:

Current Treatment

- Perforations closed in surgery
  - Minimal morbidity and mortality
- Treatment of perforations caused by/related to surgery discovered post operation
  - Significant rise in morbidity and mortality
- Death
  - Immediate inflammation from contamination
  - Progression to sepsis and septic shock
- Drain and remove septic focus
  - Aggressive surgical approach
  - High mortality
- Stent placement
  - Additional surgeries to drain and remove septic focus

E-Vac

- Vacuum assisted closure of wounds
- Improved and faster healing
  - Remove infection, reduce edema, increase perfusion, promote tissue formation
- Products
  - Endo-Sponge: currently only FDA approved in treatment anastomotic leaks involving rectum
  - Wound V.A.C.

Placement

- Nasogastric tube goes through nose and is brought out of mouth, small piece black polyurethane foam is trimmed to size and attached to tube with sutures with all drain holes covered

- "Piggyback" method: loop on end suture for endoscopic forceps to put into place with endoscope
    - Tube is on suction before endoscope is removed to keep sponge in place
    - Suction by connecting tube to Wound V.A.C.

Foam Changes

- Fluids and biologics buildup reduces suction
- Time in contact with tissue increases tissue in growth
- Foam change every 3-7 days
- Removal: flush saline through tube, grasp foam with forceps through endoscope and pull
- Foam changes as needed during infectious period
    - More absorption in presence of more stuff
    - Drawing procalcitonin levels as early warning (should decrease daily until normal)

Stopping Therapy

- Cavity covered with granulation tissue, 1cm or less in depth, appears sealed
- Patient started on liquid diet and advanced to soft/regular

Problems

- Currently no FDA approved device
    - Adaptation and off label use of Would V.A.C.
- Multiple endoscopic procedures
- Proper placement of foam can be technically demanding

Conclusions/action items:

This was a really good review of E-Vac therapy and I definitely have a better understanding of how it works. My next steps are to review the problem statement and brainstorm questions for the client.

Evelyn Mikkelson - Jan 24, 2026, 12:28 PM CST

The use of endoluminal vacuum (E-Vac) therapy in the management of upper gastrointestinal leaks and perforations

Nathan R. Swallwood · James W. Fleshman · Steven G. Leeds · J. S. Burdick

Abstract
Introduction Upper intestinal leaks and perforations are associated with high morbidity and mortality rates. Despite the growing experience using endoscopically placed stents, the treatment of these leaks and perforations remains a challenge. Endoluminal vacuum (E-Vac) therapy is a novel treatment that has been successfully used in Germany to treat upper gastrointestinal leaks and perforations. There currently are no reports on its use in the USA.
Methods E-Vac therapy was used to treat 11 patients with upper gastrointestinal leaks and perforations from September 2013 to September 2014. Five patients with leaks following sleeve gastrectomy were excluded from this study. A total of six patients were treated with E-Vac therapy; these included: (n = 2) iatrogenic esophageal perforations, (n = 1) iatrogenic esophageal and gastric perforations, (n = 1) iatrogenic gastric perforation, (n = 1) gastric staple line leak following a surgical repair of a traumatic gastric perforation, and (n = 1) esophageal perforation due to an invasive fungal infection. Four patients had failed an initial surgical repair prior to starting E-Vac therapy.
Results All six patients (100 %) had complete closure of their perforation or leak after an average of 35.8 days of E-Vac therapy requiring 7.2 different E-Vac changes. No deaths occurred in the 30 days following E-Vac therapy. One patient died following complete closure of his perforation and transfer to an acute care facility due to an unrelated complication. There were no complications directly related to the use of E-Vac therapy. Only one patient had any symptoms of dysphagia. This patient had severe dysphagia from an esophagogastric anastomotic stricture prior to her iatrogenic perforations. Following E-Vac therapy, her dysphagia had actually improved and she could now tolerate a soft diet.
Conclusions E-Vac therapy is a promising new method in the treatment of upper gastrointestinal leaks and perforations. Current successes need to be validated through future prospective controlled studies.

Keywords Endoscopy · Vacuum therapy · Esophagus · Gastric · Perforation · Leak

Laparoscopic foregut surgery is associated with a low risk (1–3.3 %) of an iatrogenic perforation of the stomach or esophagus [1–3]. However, the risk of perforation can increase significantly (15.6–31.2 %) in re-operative cases [3]. Most perforations are recognized and closed intraoperatively with minimal morbidity and mortality [3]. Patient morbidity and mortality significantly increase, though,

Download

EVT009-Smallwood-2016.pdf (694 kB)

2026/01/26 How to Use Endovac Therapy Video

Evelyn Mikkelson - Jan 26, 2026, 1:06 PM CST

Title: V113 How to Use Endoluminal Vacuum Therapy Video

Date: 2026/01/26

Content by: Evelyn Mikkelson

Search Term: Email from client

Citation:

SAGES - Minimally Invasive Surgery Videos, *V113 HOW TO USE ENDOLUMINAL VACUUM THERAPY*, (Sep. 30, 2015). Accessed: Jan. 26, 2026. [Online Video]. Available: https://www.youtube.com/watch?v=4bt0f9-79qs

Link: https://youtu.be/4bt0f9-79qs

Goals: Start research for this project with the links provided by the client.

Content:

Procedure

- Sponge attached to nasogastric tube to provide negative pressure
- Begin with endoscopic examination of cavity to asses size, structure, and drainage areas
- Sponge cut to size and sewn onto ng tube
- Foam is placed through mouth to desired location
    - Over tubes from Wound Vac kit
    - Piggyback by grasp suture with endoscopic forceps
    - Grasp tube with forceps
    - Double forceps use

Placement

- Needs to be placed correctly with the correct size
- Replace regularly to ensure it works

Conclusions/action items:

This was a good surgical video explaining the current methods of sponge placement. I will now move to brainstorming questions for the client.

2026/01/26 Modified Low Cost Endovac

Evelyn Mikkelson - Jan 28, 2026, 5:18 PM CST

Title: Modified Low Cost Endovac is Safe and Efficacious for Treatment of Postoperative Leaks Even at Low Pressures

Date: 2026/01/26

Content by: Evelyn Mikkelson

Search Term: UW Libraries: endovac

Citation:

S. Sundaram *et al.*, “Modified low-cost EndoVac is safe and efficacious for treatment of postoperative leaks even at low pressures,” *Surg Endosc*, vol. 39, no. 8, pp. 4857–4862, Aug. 2025, doi: 10.1007/s00464-025-11899-8.

Link: https://link-springer-com.ezproxy.library.wisc.edu/article/10.1007/s00464-025-11899-8

Goals: Learn more about the use of Endovac and its possible complications

Content:

Endoscopic Vacuum Therapy

- Device commercially available
  - Expensive
- Traditional device uses high pressure
  - Chest discomfort, lung issues
- Low cost and low pressure method (mEndoVac)

Procedure

- Modified sponge made using polyurethane wound vacuum sponge (granual foam)
- Sponge was sutured on Ryle's tube or suction catheter
- Guidewire in cavity
- Sinapi chest drainage device for suction in upper GI and wall suction for lower GI
- Sponge replaced every 4-5 days
- 2 patients initially intubated, overtube placed for placement mEndoVac
- 2 patients with difficulty placing due to angle of opening wire was passed from pigtail into cavity
  - Rendezvous procedure
- Lower pressure in upper GI (20-25 cm)
- Standard suction in lower GI (125cm)

Results

- Higher rate of closure, more device changes, shorter treatment, lower mortality than stenting
  - No significant changes short term and major complications
- Success in esophageal or rectal leaks
- Intracavity placement better than intraluminal for leak healing
  - Unless associated with closure of site

- Device costs less than the commercially available and is able to be reproduces in resource constrained settings

Conclusions/action items:

I will continue research different applications and uses of endovac to see what methods are currently being used to get it into place. Another thing I will look into is perforations and the healing process.

Evelyn Mikkelson - Jan 28, 2026, 5:17 PM CST

Modified low-cost EndoVac is safe and efficacious for treatment of postoperative leaks even at low pressures

Download

s00464-025-11899-8.pdf (998 kB)

2026/02/04 Pitfalls, Tips, Tricks, Insights and Perspectives

Evelyn Mikkelson - Feb 04, 2026, 9:06 AM CST

Title: Endoscopic Vacuum Therapy: pitfalls, tips and tricks, insights, and perspectives.

Date: 2026/02/04

Content by: Evelyn Mikkelson

Search Term: Cited in other articles researched

Citation:

D. T. H. de Moura, B. S. Hirsch, P. H. B. V. Ribas, S. Q. Silveira, H. G. Guedes, and A. M. Bestetti, “Endoscopic vacuum therapy: pitfalls, tips and tricks, insights, and perspectives,” *Transl Gastroenterol Hepatol*, vol. 9, p. 50, Jul. 2024, doi: 10.21037/tgh-23-86.

Link: https://pmc-ncbi-nlm-nih-gov.ezproxy.library.wisc.edu/articles/PMC11292076/f-maximum-upper-esophageal-sphincter-UES-opening-diameter-and-UES-nadir_fig1_221821634

Goals: Use this article to pick out patient considerations for the PDS.

Content:

EVT Related Problems

- Sponge movement, connections with leak, machine battery, full reservoir, system blockage, leakage

Sponge

- Faster healing by promoting granulation tissue
- Commercially available
- Large diameter makes placement and removal difficult
  - Increased surgical time
- Tissue ingrowth requires frequent changes

EVT Placement

- Challenging and time consuming
- Anesthesiologist assistance, fluoroscopic assist (water soluble contrast), nurses, high quality endoscope equipment, water pump
- EVT over 0.035in guidewire
  - Overtube, forceps, grasper, snares also choices
- Ultra-slim gastroscope - avoid nose mouth transfer
- Dilate small cavities for access

System Exchange

- Sponges every 3-7 days
- Modified systems can be in place for longer
  - Intracavity requires flushing every 10 days
  - Intraluminal continuous longer use (up to 15 days) means less procedures

Management

- Commonly 125-175mmHg

Adverse Effects

- Prolonged hospital stay and multiple exchanges may result in distress
- Extra care with NGT fixation
  - Nasal wing necrosis and nose deformation with continuous compression nasal wall
  - Alternative is fixation between nose and mouth
- EVT in upper tract concern for major bleeding from development fistula with aorta or branches
  - Formation and rupture pseudoaneurysm in ongoing healing is risk
- Post EVT stricture
  - Also in other treatments
  - Cause not well known
  - Esophagus and stomach
  - Most successfully treated with dilation

Patient

- Discomfort of tube
- Restrictive oral diet
- Many procedures

Conclusions, action items:

This was a good article summarizing all recommendations. I will implement some of this in the PDS and keep the homemade/modified EVT methods in mind for possible designs.

Evelyn Mikkelson - Feb 04, 2026, 9:06 AM CST

Endoscopic vacuum therapy: pitfalls, tips and tricks, insights, and perspectives

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tgh-09-23-86.pdf (4.05 MB)

2026/02/19 Swallowable Expandable Fibrous Capsules

Evelyn Mikkelson - Feb 19, 2026, 2:09 PM CST

Title: Swallowable Expandable Fibrous Capsules for Nonendoscopic Sampling of Esophageal Cells

Date: 2026/02/19

Content by: Evelyn Mikkelson

Search Term: Google: biocompatible dissolvable capsule

Citation:

> S. M. S. Shahriar *et al.*, “Swallowable expandable fibrous capsules for nonendoscopic sampling of esophageal cells,” *Science Advances*, vol. 11, no. 46, p. eaeb3892, Nov. 2025, doi: 10.1126/sciadv.aeb3892.

Link: https://www.science.org/doi/10.1126/sciadv.aeb3892

Goals: Begin research of materials that can be used as a coating on our sponge

Content:

Use

- Atraumatic high yield mucosal sampling
- Swallowable device
- Capsule dissolution and embedded matric expansion

Device Design

- ExSph-Cap andExCub-Cap
  - Gas foaming expansion of electrospun polycaprolactone (PCL) nanofiber mats into sphere/cube
- HaSph-Cap
  - Hybrid aerogel by entangling PCL fibers into a sponge
  - Gelatin cross linkers for structure, mechanical, resist compression
  - Compressed and encased in polyvinylpyrrolidone (PVP)
- Optimized to expand with contact gastric fluid, shape to esophagus
- In gastric environment shell dissolves within 2 min

Fabrication

- HaSph-Cap = hybrid aerogel based spherical capsule
  - 1:1 suspension cryosection fibers in aqueous gelatin
  - Molding into hemispheres
  - Freezing and freeze drying
  - Vapor crosslinked using glutaraldehyde (GA) to stabilize gelatin matrix
- ExSph-Cap = expanded sphere nanofiber capsule
  - Cut semicircles from nanofiber mats
  - Thermal welding straight edges
  - Gas foaming expansion --> 3D structures
  - Coated in gelatin, dried, GA crosslinked, tethered

    - Compressed device loaded into capsules
- ExCub-Cap = expanded cube nanofiber capsule
    - Tether to center of cube
    - Crosslinked, compressed, encapsulated

Dissolving

- Dip coating method PVP
- Single layer = 150s in water and 100s in gastric
- Double layer = 250s in water and 150s in gastric
- Triple layer = over 300s in both
- Time can be tuned by adjusting wall thickness and layering
- Upon capsule dissolution recovered full shape

Conclusions, action items:

These techniques sound a little too advanced for our skillset. Additionally, it is probably too short of a timescale with an inappropriate dissolution environment.

Evelyn Mikkelson - Feb 19, 2026, 2:07 PM CST

SCIENCE ADVANCES | RESEARCH ARTICLE

HEALTH AND MEDICINE

Swallowable expandable fibrous capsules for nonendoscopic sampling of esophageal cells

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sciadv.aeb3892.pdf (5.22 MB)

2026/02/19 Dissolvable Films

Evelyn Mikkelson - Feb 19, 2026, 2:18 PM CST

Title: Dissolvable Films

Date: 2026/02/19

Content by: Evelyn Mikkelson

Search Term: Google: dissolvable materials medical

Citation:

> “Dissolvable Films | Precise, Customizable Drug-Loaded Layers,” ARx Pharma. Accessed: Feb. 19, 2026. [Online]. Available: https://arxpharma.com/technologies/dissolvable-films/

Link: https://arxpharma.com/technologies/dissolvable-films/

Goals: Try to find dissolvable materials for coating/sealing sponge.

Content:

Dissolvable Films

- Activated at specified timeframes, in different media
- Each film layer can have different properties/ingredients

Dosage/Application

- Buccal - inner cheek
- Sublingual - under the tounge
- Lingual - tongue

Conclusions, action items:

Browsed website and it seems they deal with medicine distribution that is not swallowed, so probably not ideal but cool concept.

Evelyn Mikkelson - Feb 19, 2026, 2:20 PM CST

Download

ARxPharma.pdf (3.08 MB)

2026/02/20 Biodegradable Materials

Evelyn Mikkelson - Feb 20, 2026, 5:38 PM CST

Title: Biodegradable Materials for Sustainable Health Monitoring Devices

Date: 2026/02/20

Content by: Evelyn Mikkelson

Search Term: Google: biodegradable medical products

Citation:

E. S. Hosseini, S. Dervin, P. Ganguly, and R. Dahiya, “Biodegradable Materials for Sustainable Health Monitoring Devices,” *ACS Appl Bio Mater*, vol. 4, no. 1, pp. 163–194, Jan. 2021, doi: 10.1021/acsabm.0c01139.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC8022537/

Goals: Continue research on degradable materials in medical devices.

Content:

Structural and Functional Materials

- Tailoring polymers
  - Naturally derived
    - Protein based: collagen, chitosan, fibrin, silk, gelatin
    - Plant based polysaccharides: alginate, cellulose, dextran, starch
    - Inherent bioactivity
    - Weak mechanical, structural complexity, variation between batches
  - Synthetic
    - Control physiochemical properties (controlled and reproducible conditions)
- Degradation by cleavage unstable sights on polymer backbone
  - Natural = enzymatic
  - Synthetic = hydrolytic degradation in acidic or basic environment
    - Si nanomembranes
    - Mg, Mo, Fe, Zn alloys

Naturally Derived Polymer Substrates

- Silk and regenerated silk
  - Well characterized degradation rate, FDA approved
  - Crystallinity increases makes silk more brittle and difficult
  - Rapid degradation
  - Incompatible with aqueous processing
  - Mechanically flexible
  - Dissolution months to years
    - Broken down by enzymes in foreign body reaction

- Cellulc
  - F
  - F
  - C

nalytes

- Chitin
  - H
  - C

natory, hemostatic

ers (synthetic or natural)

- Other
  - S
  -

eaweed, cheese

Synthetic Polymers

- Mechanical and rate degradation hard to tune for natural
  - Can elicit immune response
- Reproducible mechanical and disintegration performances
- PLA: similar to hydrocarbon polymers, can be produced from lactic acid
- PVA: degrade after 7 days deionized water

Metal Substrates

- Mo, Fe, W, Zn foils

Encapsulants and Adhesives

- Sucrose
- PLGA, PVA, POC, PCL
- Controlled by air pockets between silk layers

Conclusions, action items:

While the broad topic was applicable to our device, it was mostly centered around degradable sensors/electronics. I am going to look more into capsules and materials that could act as a vacuum seal.

Evelyn Mikkelson - Feb 20, 2026, 5:39 PM CST

APPLIED BIO MATERIALS

Biodegradable Materials for Sustainable Health Monitoring Devices

Ershad S. Hosseini, Saoirse Dervin, Priyanka Ganguly, and Ravinder Dahiya*

ACCESS | Metrics & More | Article Recommendations

ABSTRACT: The recent advent of biodegradable materials has offered huge opportunity to transform healthcare technologies by enabling sensors that degrade naturally after use. The implantable electronic systems made from such materials eliminate the need for extraction or evaporation, minimize chronic inflammatory responses, and hence offer attractive propositions for future biomedical technology. The eco-friendly sensor systems developed from degradable materials could also help mitigate some of the major environmental issues by reducing the volume of electronic or medical waste produced and, in turn, the carbon footprint. With this background, herein we present a comprehensive overview of the structural and functional biodegradable materials that have been used for various biodegradable or bioresorbable electronic devices. The discussion focuses on the dissolution rates and degradation mechanisms of materials such as natural and synthetic polymers, organic or inorganic semiconductors, and hydrolyzable metals. The recent trend and examples of biodegradable or bioresorbable materials based sensors for body monitoring, diagnostic, and medical therapeutic applications are also presented. Lastly, key technological challenges are discussed for clinical application of biodegradable sensors, particularly for implantable devices with wireless data and power transfer. Promising perspectives for the advancement of future generation of biodegradable sensor systems are also presented.

KEYWORDS: biodegradable materials, bioresorbable materials, naturally degrading sensors, implantable sensors, sustainable electronics, health monitoring

1. INTRODUCTION

Over the past decade, biodegradable sensors and electronic devices that naturally degrade or fully dissolve in their physiological environments have emerged as attractive alternatives for both invasive and noninvasive health monitoring.[1−3] They provide a unique opportunity for temporary medical implants for continuous body conditions monitoring and in-vivo sensing. With flexible form factors, such sensor systems integrated on wearables or clothing could offer a hygienic route for monitoring of various physiological parameters.[4−7] The ability for real-time monitoring of parameters such as strain, pressure, temperature, pH, oxygen, and other specific biomarkers would exponentially improve the information about tissue healing, early stage detection of post-surgical infection, and personalized treatments.[1,2,8−11] Besides, they are ideal for single-shot measurements in point of care diagnostics as they are environmentally friendly and reduce the medical waste associated with disposable sensors and are usually low-cost.[12,13]

Most of the sensors that are used today in medical healthcare are often outside the body or noninvasive, and those implanted into the body have the disadvantage of removal surgery that exposes patients to the dangers of retrieval and additional complications.[1,2,14] Resorbable devices offering short-term performance are excellent temporary implants for diagnostic and therapeutic applications that need to operate only for a assigned duration and later erode without the need for surgical removal,[1] thus promoting extensively to the patient's comfort and eliminating the cost and risks of removal surgery. Additionally, using bioresorbable and biodegradable materials for sensor fabrication minimizes the foreign body reactions to implants.

The main achievements in the development of biodegradable sensors are quite new and have started from about a decade ago with partially degradable sensors materials and recently with further advances in functional materials and fabrication methods, fully biodegradable systems that include power sources, circuitry, and wireless technologies in flexible form-factors.[15] Obtaining suitable materials for degradable sensors is challenging, considering that the materials they need to use should be atoxic, biocompatible, biodegradable, and yet exhibit high performance electrical (optical) mechanical properties. Flexibility and appropriate mechanical properties for conformal interfacing and minimal stresses on the tissue are other important aspects. The perfect route for such electronic

Special Issue: Wearable and Biodegradable Sensors

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ACS Publications

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2026/02/27 Porous Coating Orthopedic Implant

Evelyn Mikkelson - Feb 27, 2026, 12:15 PM CST

Title: Porous Coating for Orthopedic Implant Utilizing Porous, Shape Memory Materials

Date: 2026/02/27

Content by: Evelyn Mikkelson

Search Term: Google: nitinol in polyurethane sponge

Citation:

> M. Fonte and M. Palmer, “Porous coating for orthopedic implant utilizing porous, shape memory materials,” US9278000B2, Mar. 08, 2016 Accessed: Feb. 27, 2026. [Online]. Available: https://patents.google.com/patent/US9278000B2/en

Link: https://patents.google.com/patent/US9278000B2/en

Goals: Learn more about possibly integrating nitinol into the sponge.

Content:

Summary of Invention

- Coating of shape memory polymers
  - Can be processed to have super elasticity (SE) or shape recovery
- Porous coating for implant containing porous shape memory material
- Inserting implant to porous coating so it puts outward force on bone to create interface

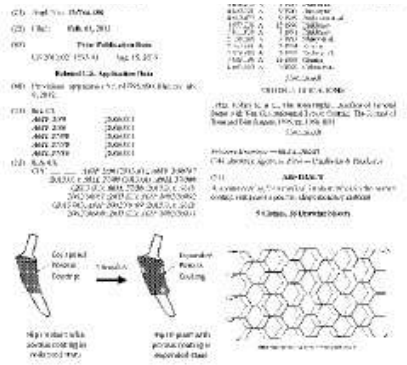
Shape Memory Material (SMM)

- Nitinol, Ti-13Nb-13Zr, Ti-12Mo-6Zr-2Fe
  - Expands to apply strain against bone for remodeling
- Polyurethane foam with deposited powder Nitinol coating via low temperature arc vapor deposition
  - Followed by sintering to implant
- Honeycomb structure from SMMs for SE and shape memory effects (SME)
  - Repeating patterns of any shape

Conclusions, action items:

I think that this would be a cool idea to pursue. I am going to look for more ways to make the polyurethane sponge have shape memory.

Evelyn Mikkelson - Feb 27, 2026, 12:15 PM CST



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2026/02/27 Bioactive Polyurethane Shape Memory Polymer

Evelyn Mikkelson - Feb 27, 2026, 12:57 PM CST

Title: Bioactive Polyurethane Shape Memory Polymer Foam Dressings with Enhanced Blood and Cell Interactions for Improved Wound Healing

Date: 2026/02/27

Content by: Evelyn Mikkelson

Search Term: Google: nitinol in polyurethane sponge

Citation:

> N. M. Petryk, N. L. B. Thai, L. V. Saldanha, S. T. Sutherland, and M. B. B. Monroe, “Bioactive Polyurethane Shape Memory Polymer Foam Dressings with Enhanced Blood and Cell Interactions for Improved Wound Healing,” *ACS Appl Mater Interfaces*, vol. 17, no. 18, pp. 26402–26415, Apr. 2025, doi: 10.1021/acsami.5c02532.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC12067373/

Goals: Learn more about shape memory sponge, especially with this application.

Content:

How it Works

- Polyurethane (PUr) shape memory polymer (SMP) foam
- Bleeding control, address non compressible bleeds, safe for prolonged use, tunable
- Synthetic nature limits use long term healing if left in wound to degrade
- Incorporation bioactive collagen and gelatin
    - Clotting and cell interaction
    - Promote wound repair

Shape Memory Polyurethanes

- Biocompatible, durable, flexible, elasticPUr shape memory foams
- Volume expansion with stimulus (temperature, pH, enzymes, light, electric/magnetic)
    - Synthesizes in primary shape and secondary upon stimulus application
- Thermal
    - Synthesized in open pore, primary shape
    - Programmed by heating above Tg and deforming to second shape
    - Delivered through catheter to injury, recover secondary state with exposure to blood/body temperature
        - Fill irregular shape wound
- Tailoring
    - Degrade - if left to degrade can then act as scaffolding
- Synthetic material limits healing promotion
    - Modification with chitosan, collagen, gelatin, hyaluronic acid for biological response can improve healing outcomes
- In this study incorporated gelatin and collagen

    - Enhance healing without altering other properties of PUr

Materials and Methods

- Incorporation of gelatin and collagen
    - Foams sterilized in 70% ethanol for 1 hour and incubated in DI water overnight to remove ethanol
    - Coated in collagen following TeloCol-3 collagen recommended coating procedure
        - 200 ug/mL solution by mixing Type 1 collagen, DPBS, and 0.01 N HCL buffer for final pH 7.2-7.6
        - Foam incubated in collagen for 1h at 37deg C
    - Coated in 200 ug/mL gelatin colution
        - Gelatin dissolved in DPBS by heating solution to 50deg C with constant stirring 300rpm
        - Samples submerged and incubated 1h at 37deg C
    - Samples removed and rinsed with PBS
    - Sterilized before cell studies in UV box (254nm) for 30 minutes
- Incorporation Methacrylated Gelatin (gelMA)
    - Synthesized to work with gelatin in PUr
    - Type A porcine gelatin added at 10% w/v to DPBS and mixed in oil bath at 60deg C with constant stirring (500rpm)
    - After dissolution, temperature reduced to 50degC and 1.25% v/v methacrylic anhydride added at 0.5 mL/min and allowed to react for 1h
    - DPBS warmed to 40deg C and added at 2x volume to stop reaction
    - Solution dialyzed for 3 days using 3.5kDa weight cutoff to remove salts and unreacted methacrylic acid
    - Solution frozen at -80deg C for 24h
    - Lyophilizing 3 days
    - gelMA stored in freezer for later use
    - Dissolved in DPBS at 0.08mg/mL at 60deg C
    - 1 mg LAP photoinitator added and combined using vortexer
    - 20mg foam placed in 1mL gelMA solution for 5 min
    - Foams removed and gently pressed to remove excess
    - UV light box (365nm) for 3 min to cure

Gelatin Based Dressings

- Activation and aggregation platelets, enhance thrombin generation, structural support clot formation
- Limited by mechanical strength
- Significant swelling
- Gelfoam and Surgifoam
    - 4-6 weeks to dissolve
    - Liquify 2-5 days

Collagen Based Dressings

- Trigger coagulation cascade
- Biocompatible, cell adhesion, tissue regeneration
- Uncontrolled degradation and thermal instability
- Helistat, Collastat

Hybrid Hydrogels

- Limited control pore size and shape, hard to scale
- Other new developments require a lot of modification, synthesis, and purification

Polyurethane Dressings

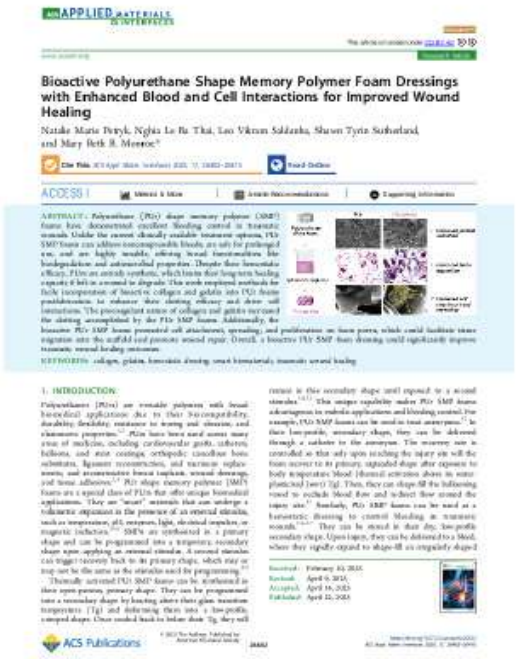
- Tunable degradation, high porosity, mechanical strength, absorbent
- ResQFoam
    - Forms in situ by injection, thermogenic foam forming

Collagen and Gelatin Enhanced Polyurethane SMP

- Combination of all properties
- Absorbent, no excessive swelling
- Applications in deep, noncompressible, irregular wounds
- Other hybrid scaffolds
    - Additional bioactive components (human amnion, soybean oil, growth factor)
- Incorporation of gelatin and collagen achieved in 1hr
- Limitation on long term stability bioactive components
    - If bioactive partially dissolved they are still effective

Conclusions, action items:

This is really interesting and something I will bring to the team. The fabrication looks a little complicated, but could be made easier by buying items (like gelMA) instead of fabricating them. I am going to look at some of the brands/designs mentioned in the article. I will also continue looking at shape memory sponges.



Bioactive Polyurethane Shape Memory Polymer Foam Dressings with Enhanced Blood and Cell Interactions for Improved Wound Healing

Natalie Marie Petryk, Nghia Le Ba Thai, Leo Vikram Saldanha, Shawn Tyrin Sutherland, and Mary Beth B. Monroe

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ACS Publications

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2026/03/02 Bacteria Responsive Drug Delivery

Evelyn Mikkelson - Mar 02, 2026, 6:32 PM CST

Title: Smart Bacteria Responsive Drug Delivery Systems in Medical Implants

Date: 2026/03/02

Content by: Evelyn Mikkelson

Search Term: Google: infection dependent drug delivery

Citation:

> Y. Yang, X. Jiang, H. Lai, and X. Zhang, “Smart Bacteria-Responsive Drug Delivery Systems in Medical Implants,” *J Funct Biomater*, vol. 13, no. 4, p. 173, Oct. 2022, doi: 10.3390/jfb13040173.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC9589986/

Goals: Learn more about how polymers can be reactive to infection.

Content:

Biomaterials

- Some have antibacterial properties
- Most antibacterial through drug delivery systems (DDS)
- Conventional DDSs can not be administered on demand
  - Sustained release - not enough near infection, leaks to antibiotic resistance
- Develop DDS that releases from implants when infections occur
  - Trigger with acidic environment, overexpression of hyaluronidase/gelatinase/phospholipase

Materials

- pH switch gentamicin-Silk protein film [16]
- pH switch chitosan/silver nanoparticles hydrogel [17]
- pH switch electrospun gelatin/sodium bicarbonate nanofiber [46]

pH Responsive

- Drops from 7.4 -> 6 or lower
  - Disruption of equilibrium polyelectrolytes

Protease Trigger

- Based on strict selectivity of protease to substrate
- Cleavage by host proteases

DDS Problems

- Multiple causes for change in microenvironment

Conclusions, action items:

This held good insight into how materials can be triggered by infection. I am going to look into some of the materials listed to see if they are feasible.

Evelyn Mikkelson - Mar 02, 2026, 6:32 PM CST

Smart Bacteria-Responsive Drug Delivery Systems in Medical Implants

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2026/03/02 Gentamicin-Silk Protein

Evelyn Mikkelson - Mar 02, 2026, 6:59 PM CST

Title: Antibacterial Application of Gentamicin-Silk Protein Coating with Smart Release Function on Titanium, Polyethylene, and Al2O3 Materials

Date: 2026/03/02

Content by: Evelyn Mikkelson

Search Term: Reference in “Smart Bacteria-Responsive Drug Delivery Systems in Medical Implants”

Citation:

> S. Sang, G. Guo, J. Yu, and X. Zhang, “Antibacterial application of gentamicin–silk protein coating with smart release function on titanium, polyethylene, and Al2O3 materials,” *Materials Science and Engineering: C*, vol. 124, p. 112069, May 2021, doi: 10.1016/j.msec.2021.112069.

Link: https://www.sciencedirect.com/science/article/pii/S0928493121002083?via%3Dihub

Goals: Learn more about this smart release material and see if it is feasible to make.

Content:

Material

- Gentamicin common broad spectrum antibiotic
  - Adsorb to surface for sustained release
- Silk protein for drug loading and release
  - Isoelectric 4.2, so release increases in acidic environment

Silk Fibroin Preparation

- 5 wt% silk protein solution as in previous report
  - Bought silkworms
  - Cocoons cut in small pieces and boiled in aqueous Na2CO3 (0.5wt%) for 1h to remove protein
  - Cocoons dissolved in 9.5M LiBr solution and dialyzed to harvest silk fibroin solution
  - Determined concentration solution

Material Coating

- Discs of chosen material placed in petri dish and 2uL 5% silk protein applied using pipette
- Solution dried at room temperature and 2uL solution was applied twice
- After it is completely dry disk was turned and procedure repeated
- Following application sheet was immersed in 1mg/mL gentamicin sulfate solution for 15min and dried
- Coating with silk protein again (x3)
- Dried at room temperature

Results

- Silk protein can effectively load gentamicin

- Materials release gentamicin for more than 72h in aqueous solution
- Immersion in pH 5.5 accelerates release
- Coating is not easy to pull off

Conclusions, action items:

I feel like this is a good material to more forward with. My only concerns are the price of the materials, and the pH/duration of degradation. We might be able to shift it, so will bring up to team.

Evelyn Mikkelson - Mar 02, 2026, 6:59 PM CST

Materials Science & Engineering C

Antibacterial application of gentamicin–silk protein coating with smart release function on titanium, polyethylene, and Al_2O_3 materials

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1-s2.0-S0928493121002083-main.pdf (21.1 MB)

2026/03/03 Electrospun Gelatin/Sodium Bicarbonate

Evelyn Mikkelson - Mar 03, 2026, 12:49 PM CST

Title: Electrospun Gelatin/Sodium Bicarbonate and Poly(lactide-co-e-calprolactone)/Sodium Bicarbonate Nanofibers as Drug Delivery System

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Reference in “Smart Bacteria-Responsive Drug Delivery Systems in Medical Implants”

Citation:

> Q. Sang, G. R. Williams, H. Wu, K. Liu, H. Li, and L.-M. Zhu, “Electrospun gelatin/sodium bicarbonate and poly(lactide-*co*-ε-caprolactone)/sodium bicarbonate nanofibers as drug delivery systems,” *Materials Science and Engineering: C*, vol. 81, pp. 359–365, Dec. 2017, doi: 10.1016/j.msec.2017.08.007.

Link: https://www.sciencedirect.com/science/article/pii/S0928493117321793?via%3Dihub

Goals: Learn more about this material and see if it is feasible.

Content:

Materials

- Nanofibers electrospun from stimuli responsive materials
- In acidic conditions sodium bicarbonate reacts with protons to form CO2 gas
  - Pores in fibers for drug diffusion
  - Non porous in neutral pH
- Gelatin is hydrophilic biopolymer, good biocompatibility
  - Dissolves quickly in aqueous media
  - Silk Fibroin/Gelatin multilayer film [14]
    - Complex fabrication
  - Crosslink gelatin in fibers after fabrication using glutaraldehyde

Electrospinning

- Gelatin dissolved in hexafluoroisopropanol (HFIP) - with or without sodium bicarbonate (SB)
- Solutions magnetically stirred at room temperature for 24h in closed glass bottles sealed with parafilm
- Loaded in 5mL plastic syringes with stainless steel spinneret (0.5mm internal diameter)
- Syringe pump to drive fluids at rate 0.8mL/h
- Potential difference 15kV
- Performed at 20-25degC and 33-45% humidity
- Dried in vacuum oven for two days at 25degC
- Gelatin fibers crosslinked using aqueous glutaraldehyde solution
  - 10mL solution placed at bottom brown translucent desiccator and fiber samples loaded in petri dish and mounted on rack above solution for 8h

Results

- Gelatin has pH sensitive rapid release

Conclusions, action items:

I do not think we have the equipment to do this but it is an interesting subject. I am going to continue looking at materials incorporating gelatin, or the possibility of adding sodium bicarbonate to make things pH degradable.

Evelyn Mikkelson - Mar 03, 2026, 12:44 PM CST


Materials Science & Engineering C

Electrospun gelatin/sodium bicarbonate and poly(lactide-co-ε-caprolactone)/sodium bicarbonate nanofibers as drug delivery systems

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2026/03/03 Gelatin Tannic Acid Multilayers

Evelyn Mikkelson - Mar 03, 2026, 2:56 PM CST

Title: Proteolytic Degradation of Gelatin-Tannic Acid Multilayers

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Google: gelatin protease degradable material

Citation:

S. Bahmanzadeh, T. Ruzgas, and J. Sotres, “Proteolytic degradation of gelatin-tannic acid multilayers,” *Journal of Colloid and Interface Science*, vol. 526, pp. 244–252, Sep. 2018, doi: 10.1016/j.jcis.2018.04.112.

Link: https://www.sciencedirect.com/science/article/pii/S002197971830506X

Goals: Learn more about this material and see if it is feasible.

Content:

Gelatin Films

- Widely used protein
- Low gas permeability, poor mechanical permeability
  - Fix by crosslinking with other compounds
- Use tannic acid (TA) to crosslink gelatin
  - Better water barrier and mechanical properties
- Gelatin TA films at low ionic strength quickly degraded by proteases

Materials (Sigma-Aldrich)

- Gelatin from cold water fish skin
- Poly-L-Lysine hydrobromide (PLL)
- PBS buffer

Layer by Layer Growth

- Multilayers grown from gelatin, tannic acid, and PLL solutions at 0.1 mg/mL concentration in PBS buffer
  - After preparation solutions stored at -20degC and only thawed just before use
- PLL solution flowed through chamber for 10 min, flow stopped and layer stabilized for 10 min, buffer rinsed for 10min
- Gelatin and tannic acid formed with same steps/time
  - 5 layers

Results

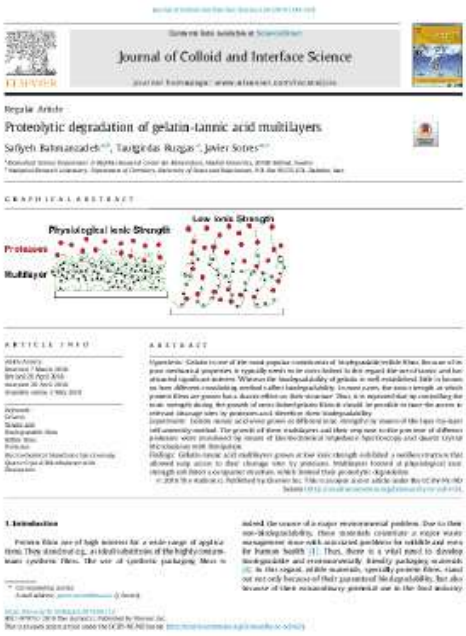
- Proteolytic degradation takes longer at low ionic strength
  - At low degraded almost immediately
- With Au nanoparticles completely resisted proteolytic degradation

- Low ionic possibility for electrochemical sensor for bacteria/biofilm

Conclusions, action items:

I don't think we have the means to fabricate this and it looks like the degradation would be too fast. I will continue looking.

Evelyn Mikkelson - Mar 03, 2026, 2:57 PM CST


Journal of Colloid and Interface Science

Regular Article

Proteolytic degradation of gelatin-tannic acid multilayers

Safiyeh Bahmanzadeh, Tarigeldas Ruggas, Javier Sotres

GRAPHICAL ABSTRACT

Physiological Ionic Strength

Low Ionic Strength

Proteases

Multilayer

ARTICLE INFO

ABSTRACT

1. Introduction

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2026/03/03 Silk Fibroin Hydrogels

Evelyn Mikkelson - Mar 03, 2026, 3:39 PM CST

Title: Silk Fibroin Hydrogels for Biomedical Applications

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Google: silk fibroin pH degradable hydrogels

Citation:

H. Zhang, D. Xu, Y. Zhang, M. Li, and R. Chai, “Silk fibroin hydrogels for biomedical applications,” *Smart Med*, vol. 1, no. 1, p. e20220011, Dec. 2022, doi: 10.1002/SMMD.20220011.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC11235963/

Goals: Learn more about this silk fibroin.

Content:

Silk Fibroin

- Raw silk it two parallel silk fibroin fibers with sericin glued to surface
  - Degum to isolate fibroin
- Biocompatible, biodegradable, non toxic, thermally stable, mechanical strength/toughness

Silk Fibroin Hydrogels

- Tunable mechanical and degradation

Degradability

- Enzymatic promotes fragmentation -> amino acids -> bioabsorbable
- In vivo related to immune response
  - Foreign body giant cells and macrophages

Gelation of Silk Fibroin Hydrogel

- Physical cross linking
  - Temperature: increasing temperature increases aggregation, strengthen hydrophobic interactions, lead to self assembly that is irreversible
    - Silk fibroin solutions could be stored at 4 degC for a week because gelation occurs faster at room temperature
  - Shear forces: stirring and slowing, vortexing
  - Polar reagents: alcohols, different alcohols have different induction
  - pH: at isoelectric point (3.8-4) silk solution aggregates

Conclusions, action items:

I think that this is an interesting material and need to look more into what we would add to make it better suited to our application.

Evelyn Mikkelson - Mar 03, 2026, 3:39 PM CST

REVIEW

Smart Medicine

Silk fibroin hydrogels for biomedical applications

Hui Zhang | Dongyu Xu | Yong Zhang | Minli Li | Renjie Chai

Abstract

Silk fibroin hydrogels occupy an essential position in the biomedical field due to their remarkable biological properties, excellent mechanical properties, flexible processing properties, as well as abundant sources and low cost. Herein, we introduce the unique structures and physicochemical characteristics of silk fibroin, including mechanical properties, biocompatibility, and biodegradability. Then, various preparation strategies of silk fibroin hydrogels are summarized, which can be divided into physical cross-linking and chemical cross-linking. Emphatically, the applications of silk fibroin hydrogel biomaterials in various biomedical fields, including tissue engineering, drug delivery, and wearable sensors, are systematically summarized. At last, the challenges and future prospects of silk fibroin hydrogels in biomedical applications are discussed.

KEYWORDS

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2026/03/03 Chitosan and Silver Nanoparticle pH Dependent Release

Evelyn Mikkelson - Mar 03, 2026, 5:00 PM CST

Title: Electrochemical Synthesis of Chitosan/Silver Nanoparticles Multilayer Hydrogel Coating with pH Dependent Controlled Release Capability and Antibacterial Property

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Reference from "Smart Bacteria-Responsive Drug Delivery Systems in Medical Implants"

Citation:

> K. Yan, F. Xu, W. Wei, C. Yang, D. Wang, and X. Shi, “Electrochemical synthesis of chitosan/silver nanoparticles multilayer hydrogel coating with pH-dependent controlled release capability and antibacterial property,” *Colloids Surf B Biointerfaces*, vol. 202, p. 111711, Jun. 2021, doi: 10.1016/j.colsurfb.2021.111711.

Link: https://www.sciencedirect.com/science/article/pii/S0927776521001557?via%3Dihub

Goals: Learn more about a different material and if it is feasible.

Content:

Materials

- Medium molecular weight chitosan (deacetylation 75%-85%)
- Silver nitrate ($AgNO_3$, 99%)
- Chitosan solution by adding flakes into dilute nitric acid solution (0.5 v/v % HNO_3) to abtain final concentration 1 w/v % and pH = 5.5
    - Undissolved particles removed by porous glass filter
    - Stored at 4 degC

Electrodeposition Multilayer Chitosan

- Working and counter electrodes
- Partially immerse in solution 0.8cm and apply potential
- Pulsed signal for multiple layers

Electrochemical Synthesis AgNPs

- Coated electrodes soaked in swelling solution 0.1mM $AgNO_3$ and 0.25M for 12h to allow silver ions to load
- Collect hydrogel from swelling solution and applied 5V to reduce Ag^+ nanoparticles
- Nanocomposite rinsed, stripped from wire, frozen in liquid nitrogen and freeze dried for 6h

Dissolution Film

- 3 layer chitosan hydrogel
- pH 7.4 no degradation
- pH 1.2 3 min degradation
- pH 5.5 15 minutes single layer sample

- Polyelectrolyte effect - chitosan

Conclusions, action items:

This is a cool concept, but not sure if we could get the electrodes or liquid nitrogen. Look into chitosan being a pH dependent release.

Evelyn Mikkelson - Mar 03, 2026, 5:02 PM CST


Colloids and Surfaces B: Biointerfaces

Electrochemical synthesis of chitosan/silver nanoparticles multilayer hydrogel coating with pH-dependent controlled release capability and antibacterial property

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2026/03/03 Films Based on Chitosan, Gelatin, and Collagen

Evelyn Mikkelson - Mar 03, 2026, 5:31 PM CST

Title: Novel pH-Responsive Chitosan/Sodium Alignate/PEG Based Hydrogels for Release of Sodium Ceftriaxone

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Google: PEG and chitosan pH drug delivery

Z. H. Ghauri *et al.*, “Novel pH-responsive chitosan/sodium alginate/PEG based hydrogels for release of sodium ceftriaxone,” *Materials Chemistry and Physics*, vol. 277, p. 125456, Feb. 2022, doi: 10.1016/j.matchemphys.2021.125456.

Link: https://www.sciencedirect.com/science/article/pii/S0254058421012396

Goals: Learn more about the use of chitosan and if this mix would mechanically hold and be the right pH.

Content:

Materials

- Chitosan
- Sodium alginate
- PEG
- Formic acid
- 1,4 - diamino butane

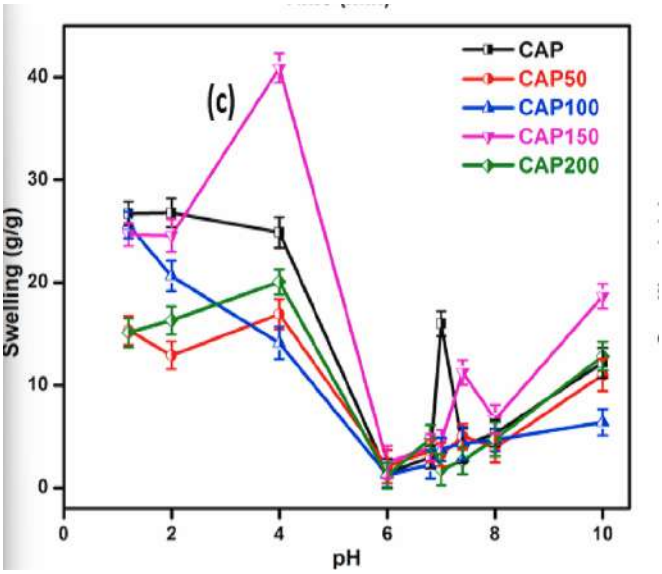
Fabrication

- Chitosan (0.5g) dissolved in 30mL of 1% solution of formic acid in distilled water at 60 degC with constant stirring hot plate for 1h
- Sodium alginate (0.3g) was dissolved in 25mL distilled water and stirred for 1h
- Both solutions mixed together and stirred for 1h
- PEG (0.2g) solution was prepared in 10mL distilled water, added to above mixture and blended further for 1h at 60deg C
- 1,4 - diamino butane of different concentrations (50,100,150,200 uL) added in the mixtures and continued stirring for 3h at 60deg C
- Bubble free mixtures transferred in dried petri dishes and dried in oven at 65degC
- Prepared hydrogels detached from dishes after completely dried

Swelling

- Variation in cross linker (1,4 - diamino butane) changed swelling
  - No crosslinker 90min -> 200uL 30min
  - Swelling increased up to 150uL linker then decreased
- Buffer solutions
  - More swelling in acidic (pH 4) and lower swelling at pH 6,7
  - Slight rise at pH 7.4 and good swelling at pH 10

- Protonation chitosan having amino groups in backbone

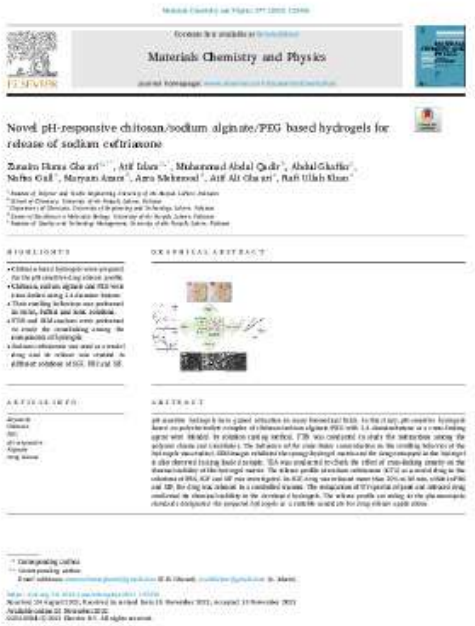


- Figure 1. pH dependency of hydrogels.

Conclusions, action items:

This is a great option and something we could fabricate if the pH of swell is closer to 6.

Evelyn Mikkelson - Mar 03, 2026, 5:28 PM CST



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1-s2.0-S0254058421012396-main.pdf (9.21 MB)

2026/03/03 Pectin Coated Nanoparticles Induce Anastomotic Healing

Evelyn Mikkelson - Mar 03, 2026, 6:08 PM CST

Title: Orally Delivered Biodegradable Targeted Inflammation Resolving Pectin-Coated Nanoparticles Induce Anastomotic Healing Post Intestinal Surgery

Date: 2026/03/03

Content by: Evelyn Mikkelson

Search Term: Google: inflammation dependent degradable coating drug delivery

Citation:

Z. H. Ghauri *et al.*, “Novel pH-responsive chitosan/sodium alginate/PEG based hydrogels for release of sodium ceftriaxone,” *Materials Chemistry and Physics*, vol. 277, p. 125456, Feb. 2022, doi: 10.1016/j.matchemphys.2021.125456.

Link: https://www.nature.com/articles/s41598-024-80886-1

Goals: Learn more about this especially because its related to anastomotic leaks.

Content:

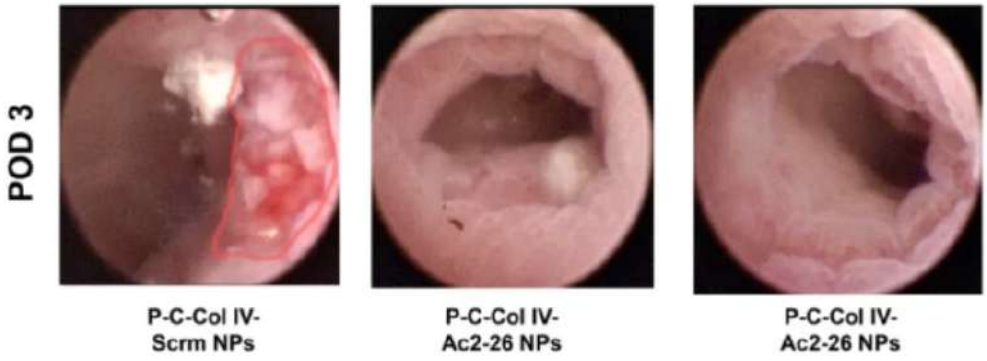
Application

- Anastomotic healing in inflammatory bowel disease (IBD) following surgery
- NPs designed to survive gastric passage and have local release in colon via microbial pectinase degradation and bind to wall through collagen IV targeting
- Annexin A1 (ANXA1) key protein to resolve inflammation
  - Binds formyl peptide receptor on phagocytes and epithelial cells
  - ANXA1 and its pharmacophore Ac2-26 candidate perioperative treatment
- Pectin-chitosan coating allows for protection against degradation during gastric passage and release with pectin digestion in colon

Results

- Enteric coated polymers rely on pH changes
- Pectin stays intact in upper GI but degraded by colon

Anastomotic Wound Closure and Intestinal Leakage



- C
- 1 µg 10 µg

Figure 1. Healing induced by nanoparticles in mice study.

Conclusions, action items:

This is a cool concept in that its protection is something only degraded in colon, but it also means it will not work in the esophagus. I am going to bring this up to the team and see if we can come up with something comparable. Additionally, I think this can be incorporated with any material we make and if we move forward with it I will look back on the materials and methods.

Evelyn Mikkelson - Mar 03, 2026, 6:09 PM CST

scientific reports

OPEN Orally delivered biodegradable targeted inflammation resolving pectin-coated nanoparticles induce anastomotic healing post intestinal surgery

Download

s41598-024-80886-1.pdf (1.97 MB)

2026/03/05 Gelatin-Polyvinyl Alcohol Film

Evelyn Mikkelson - Mar 05, 2026, 3:20 PM CST

Title: Gelatin-Polyvinyl Alcohol Film for Tissue Engineering: A Concise Review

Date: 2026/03/05

Content by: Evelyn Mikkelson

Search Term: Google: PVA gelatin film

Citation:

> I. Zulkiflee and M. B. Fauzi, “Gelatin-Polyvinyl Alcohol Film for Tissue Engineering: A Concise Review,” *Biomedicines*, vol. 9, no. 8, p. 979, Aug. 2021, doi: 10.3390/biomedicines9080979.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC8391561/

Goals: Look more into using PVA to slow degradation time.

Content:

Gelatin and PVA

- Gelatin: poor mechanical properties, thermally unstable, fast degradation
- Mixture: improve mechanical properties

Film

- Biodegradable
- Alternative to wound dressing and healing
- Advantages gelatin/PVA
    - High tensile strength, flexible,

Biomaterials

- Gelatin: natural polymer, formed by partial hydrolysis collagen, used as shell capsule and bioink, widely studied in film development
    - Type A: derived from partial acid, deliver acidic bioactive agents, pH 7-9
    - Type B: derived from alkaline hydrolysis, deliver basic bioactive agents, pH 4.8-5.1
- PVA: synthetic polymer, biodegradable, hydrophilic, flexible, good film formation, chemically crosslinked or physically entangled to overcome ageing effect, blended to improve mechanical and hydrophilic
- Neither are antimicrobial unless incorporated into another material

Fabrication

- Range depending on application
- Crosslinkers: gamma-irradiation, glutaraldehyde, none
- Combining: prepared in different solutions and combined, mixed by powder at different temperatures
- Setting: left in mold or glass plate to dry

Characterization

- Increasing gelatin increases swelling ratios due to hydrophobicity PVA
- Crosslinked film with plasticizer improved mechanical behavior
- Higher PVA content improves thermal stability
- Blends with gamma radiation improved mechanical and thermal properties
- Mechanical properties
    - Tensile strength increases with radiation
    - No significant difference in crosslinked and non-crosslinked
    - More PVA to increase tensile strength
    - Hardness of cross linked gelatin was higher that gelatin-PVA
- Thermal properties
    - Blended and irradiated samples have better thermal stability
- Swelling
    - First 15min nonirradiated film higher water uptake
    - After 7 days irradiated contains more water
    - Increasing irradiation will decrease swelling percentage
- Crosslinking and surface hydrophilicity

Casting Method

- Most studies 1:1 ratio, but depends on application
- Different ways of drying
    - Oven may improve drying, decrease drying time, may affect function
    - Room temperature require air flow, require up to 6 days
- Crosslinkers improve linkage substances
    - Genipin to prevent damage scaffold/film

Surface

- Higher concentration gelatin to PVA improve smoothness of surface
- Higher dose irradiation may cause roughness
- Irradiation over glutaraldehyde to crosslink for toxicity reasons

Challenges and Limitations

- Need controlled environment for fabrication
- Time consumption in drying
- Dissolving PVA took was long depending on degree hydrolysis
- Gelatin rejected based on origin for cultural, religious, customer reasons
- Can not be stored for an extended period of time because hydrolysis

Conclusions, action items:

This was a good summary. To learn more insight I should look at a article specific to something that mimics our design.

biomedicines

Review

Gelatin-Polyvinyl Alcohol Film for Tissue Engineering: A Concise Review

Izzat Zulkiflee and Mh Busra Fauzi *

Center for Tissue Engineering and Regenerative Medicine, Faculty of Medicine, Universiti Kebangsaan Malaysia, Jalan Yaacob Latiff, Bandar Tun Razak, Kuala Lumpur 56000, Malaysia; izzatzulkiflee@gmail.com
* Correspondence: busrafauzi@ukm.edu.my

Abstract: The field of biomaterials has been steadily expanding as a large number of pharmaceutical and manufacturing companies invest in research in order to commercialize biomaterial products. Various three-dimensional biomaterials have been explored including film, hydrogel, sponge, microspheres etc., depending on different applications. Thus, gelatin and polyvinyl alcohol (PVA) are widely used as a natural- and synthetic-based biomaterial, respectively, for tissue engineering and clinical settings. The combination of these materials has proven its synergistic effects in wound-healing applications. Therefore, this review aims to highlight the hybrid gelatin and PVA thin film development and evaluate its potential characteristics for tissue engineering applications from existing published evidence (within year 2010–2020). The primary key factor for polymer mixing technology might improve the quality and the efficacy of the intended polymers. This review provides a concise overview of the current knowledge for hybrid gelatin and PVA with the method of fabricating and mixing technology into thin films. Additionally, the findings guided to an optimal fabrication method and scrutinized characterization parameters of fabricated gelatin-PVA thin film. In conclusion, hybrid gelatin-PVA thin film has higher potential as a treatment for various biomedical and clinical applications.

Keywords: gelatin; PVA; film; scaffold; tissue engineering

1. Introduction

1.1. Tissue Engineering

The tissue engineering (TE) field is an advanced research discipline primarily focusing on producing tissues and organ replacements by regulating cellular and biomechanical parameters in the laboratory. TE triad includes the cells as a tissue-building unit whereby biscaffold acts as a platform for the cells to grow, creating solid tissue form and the biomolecules component act as enhancer or supplement. Figure 1 shows the three essential components in TE. The exponential development of biomaterial technology has revolutionized its use in the biological and medical fields over the past few decades [1]. Given their widely used applications as bioequivalent materials, polymer blends are very significant and belong to a rapidly advanced branch of polymer science and technology as well as medical applications. In the medical field, polymer blends are used in acute wounds namely burn, trauma, radiation and surgery or chronic disease such as diabetes, obesity and ulcers (pressure ulcers) or delayed acute wound healing [2]. In the interests of the quality of patient care and medical research, this will revolutionize medicine towards the various field of drug delivery, drug resistance, gene therapy, diagnostics, medical therapies, treatment protocols, immunomodulators or stimulant therapy, surgical interventions and related research areas [3].

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2026/03/05 Chitosan-Polyvinyl Alcohol

Evelyn Mikkelson - Mar 05, 2026, 3:51 PM CST

Title: Preparation of Chitosan-Polyvinyl Alcohol Blends and Studies on Thermal and Mechanical Properties

Date: 2026/03/05

Content by: Evelyn Mikkelson

Search Term: Google: chitosan PVA film

Citation:

A. Abraham, P. A. Soloman, and V. O. Rejini, “Preparation of Chitosan-Polyvinyl Alcohol Blends and Studies on Thermal and Mechanical Properties,” *Procedia Technology*, vol. 24, pp. 741–748, Jan. 2016, doi: 10.1016/j.protcy.2016.05.206.

Link: https://www.sciencedirect.com/science/article/pii/S2212017316302973

Goals: Look more into using PVA to slow degradation time.

Content:

Chemicals

- 85% deacetylated Chitosan
- Acetic acid
- PVA
- Formaldehyde
- Glycerol

Preparation Chitosan PVA Film

- Casting method
- Chitosan solution by dissolving varied concentrations in 50mL 1% aqueous acetic acid solution using sonicator
- 5g PVA dissolved in 50mL water via mechanical stirrer
- Solutions mixed to homogenous solution using sonicator
- Blend poured into glass plate and put in oven at 70deg C for 4-5 hours
- Film thickness determined by solution volume

Preparation Chitosan-PVA-Glycerol Films

- Varied amounts chitosan dissolved in 50mL 1% acetic acid solution
- 25% wt/wt glycerol (of polymer weight) added and sonicated to make homogenous
- Add 50mL PVA and mix well with mechanical stirrer
- Poured on glass plate and put in oven 70degC for 4-5 hours
- Film thickness controlled by solution volume

Mechanical Properties

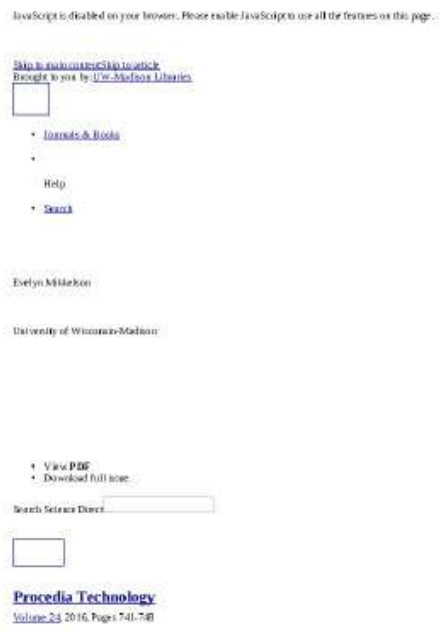
- Increasing chitosan and decreasing PVA decreases mean tensile strength and elongation

- Addition of glycerol increased elongation and decreased tensile strength

Conclusions, action items:

This was a good overview of what it would take to fabricate the material. However, I would need to find more about the degradation characteristics.

Evelyn Mikkelson - Mar 05, 2026, 3:52 PM CST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Evelyn Mikkelson

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2026/03/12 Alginate, Gelatin, and Hyaluronic Acid

Evelyn Mikkelson - Mar 12, 2026, 12:38 PM CDT

Title: Synthesis and Evaluation of Alginate, Gelatin, and Hyaluronic Acid Hybrid Hydrogels for Tissue Engineering Applications

Date: 2026/03/12

Content by: Evelyn Mikkelson

Search Term: Google: PLA hyaluronic acid gelatin degradable film

Citation:

> A. Serafin, M. Culebras, and M. N. Collins, “Synthesis and evaluation of alginate, gelatin, and hyaluronic acid hybrid hydrogels for tissue engineering applications,” *International Journal of Biological Macromolecules*, vol. 233, p. 123438, Apr. 2023, doi: 10.1016/j.ijbiomac.2023.123438.

Link: https://www.sciencedirect.com/science/article/pii/S0141813023003240

Goals: Look at some of the materials we talked about at the meeting with Prof. Ohnsorg.

Content:

Alginate

- Biocompatible, low cost
- Reversibly crosslinked with Ca2+ ions
- Release of ions reverses crosslink - short degradation time

Hyaluronic Acid

- ECM component
- Repulsion of carboxyl groups cause swelling in physiological conditions
- Crosslinked to improve mechanical and degradation

Gelatin

- Denatured hydrolyzed collagen (ECM)
- Biocompatible, degradable,
- Crosslinked to increase degradation temperature, mechanical
    - Genipin, glutaraldehyde

Synthesis

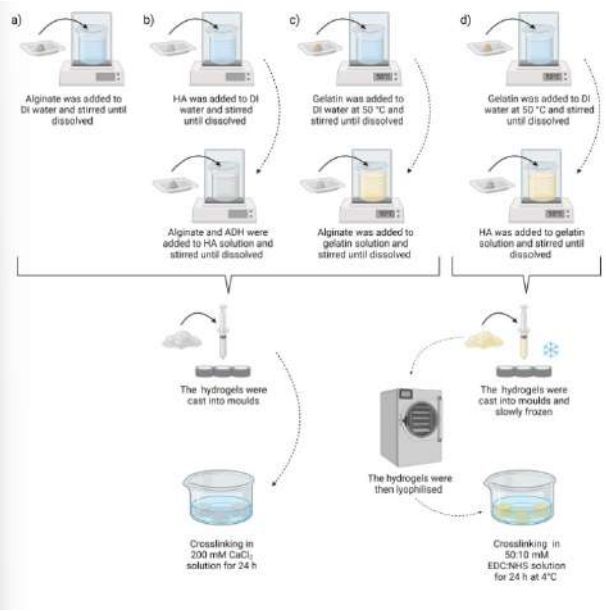


Figure 1. Process of synthesis for a) Alginate, b) Alginate:HA, c) Alginate:Gelatin, and d) Gelatin:HA.

Mechanical Properties

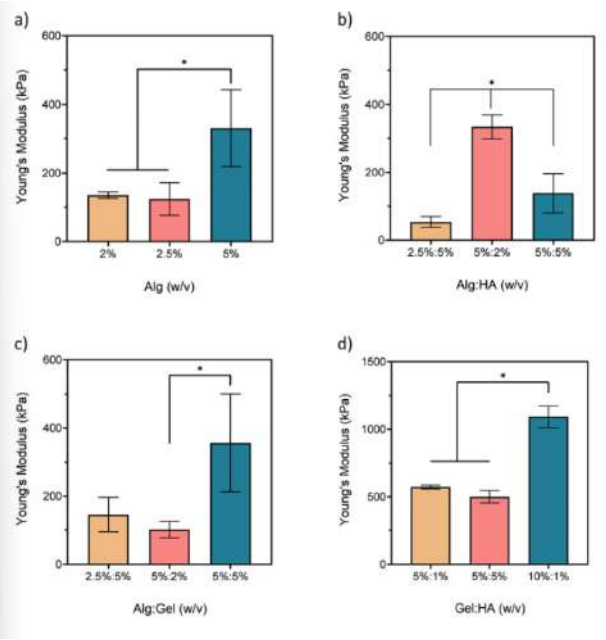
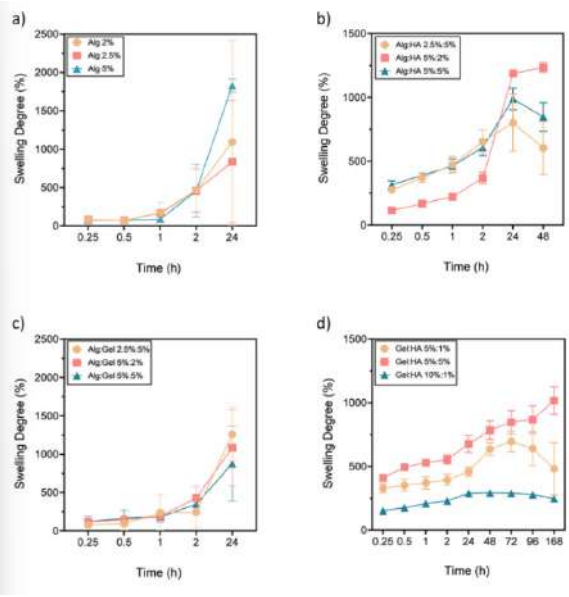


Figure 2. Young's Modulus of a) Alginate, b) Alginate:HA, c) Alginate:Gelatin, and d) Gelatin:HA.

- Increasing concentration of alginate and gelatin increased Young's Modulus and addition of HA decreased it
  - Analysis of Alginate:HA difficult because crosslinking was ineffective

Swelling Degree



Swelling of a) Alginate, b) Alginate:HA, c) Alginate:Gelatin, and d) Gelatin:HA

- Alginate swelling increased rapidly and completely dissolved into PBS
- Alginate:Gelatin same pattern
- Alginate clearance
  - Molecular weights degraded alginates may be higher than threshold of kidney renal clearance
- Alginate:HA dissolved past 48h

Summary

- Alginate hydrogels - quick degradation, high swelling, lack cell binding
- Alginate:Gelatin - little influence on mechanical/morphological/swelling properties
- Gelatin:HA - minimal swelling, good mechanical properties
- Alginate:HA - a lot of variation in mechanical properties

Conclusions, action items:

This was a good article to learn more about fabrication of hydrogels and the resulting mechanical properties. I am going to look more into the clearance of alginate.

Evelyn Mikkelson - Mar 12, 2026, 12:39 PM CDT

International Journal of Biological Macromolecules

Synthesis and evaluation of alginate, gelatin, and hyaluronic acid hybrid hydrogels for tissue engineering applications

Aleksandra Serafin, Maria Culebras, Maurice N. Collins

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2026/03/13 Alginate Biopolymer

Evelyn Mikkelson - Mar 13, 2026, 12:23 PM CDT

Title: Alginate as a Promising Biopolymer in Drug Delivery and Wound Healing

Date: 2026/03/13

Content by: Evelyn Mikkelson

Search Term: Google: alginate film drug delivery

Citation:

> M. A. S. Abourehab *et al.*, “Alginate as a Promising Biopolymer in Drug Delivery and Wound Healing: A Review of the State-of-the-Art,” *Int J Mol Sci*, vol. 23, no. 16, p. 9035, Aug. 2022, doi: 10.3390/ijms23169035.

Link: https://pmc.ncbi.nlm.nih.gov/articles/PMC9409034/#abstract1

Goals: Look more into alginate degradability.

Content:

Alginate

- Obtained from cell wall of brown seaweed
- Commercially accessible in salt form (sodium alginate)
- Commercially available ALG has average molecular weight 32,000-400,000 g/mol
- Biocompatible biodegradable, marginal toxicity
- Produce stable gel with addition cations
- Create semi-solid or solid framework (sol/gel)
- Antioxidant and anti-inflammatory

Hydrogel Formation

- Ionic cross linking
  - Combining in aqueous ALG mixture with cross linkers (CaCl2)
  - Use phosphate rich buffer to control gel formation
  - Rate of gelation affects strength and consistency
    - High = homogenous, better mechanical strength
  - Temperature impacts gelation speed and gel performance
    - Low = slows crosslinking
- Covalent cross linking
  - Being studied to enhance stability
- Photo cross linking
  - New method that takes advantage of covalent cross linking
- Click chemistry reactions
  - Another strategy for preparing covalently cross linked hydrogels
- Thermal gelling
  - ALG not intrinsically thermosensitive
- Cell cross linking

    - Using cells to promote gel production
- Other novel methods ALG gelation
    - Cyrogelation
    - Non solvent induced phase separation
    - Carbon dioxide induced
    - Carboxylic (oxalic, citric, maleic induced gelation
        - Form gel beads by expelling ALG solution (4% w/v) into acidic solution (0.5M)
        - Gel breakdown not observed after washes in ph7 aqueous medium
    - Aerogels
        - Produce highly adsorption efficient microparticles

Drug Delivery

- Microspheres, hydrogels, beads, liposomes, nanoparticles, nanofibers

Wound Healing

- Applications in tissue regeneration and bioactive delivery because its biodegradable and has slow dissolution in biological fluids when cross linked
- Adjust rate of degradation by controlling oxidation and reducing ALG molecular weight

Conclusions, action items:

This was a good overview of alginate and how it can be fabricated and used. I will continue to look into degradation characteristics.

Evelyn Mikkelson - Mar 13, 2026, 12:23 PM CDT

Alginate as a Promising Biopolymer in Drug Delivery and Wound Healing: A Review of the State-of-the-Art

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2026/03/24 PVA 3D Printing

Evelyn Mikkelson - Mar 24, 2026, 2:55 PM CDT

Title: 3D Printing Scaffold PVA

Date: 2026/03/13

Content by: Evelyn Mikkelson

Search Term: Bambu Store: PVA

Citation:

> “PVA,” Bambu Lab US Store. Accessed: Mar. 24, 2026. [Online]. Available: https://us.store.bambulab.com/products/pva

Link: https://us.store.bambulab.com/products/pva

Goals: Look into the 3D printing scaffold PVA someone mentioned at show and tell.

Content:

Features

- Easily dissolved in water
- Recommended support for PLA
- Diameter 1.75mm +/- 0.03mm

Cautions

- ONLY used for support, not standalone models
- Dry before use

Conclusions, action items:

Although it says it is only for support I think it is something we should ask the Makerspace people. If we are able to print something with it, it could be easily done by making an enclosed cylinder to shove the sponge into.

Evelyn Mikkelson - Mar 24, 2026, 7:05 PM CDT

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2026/03/26 Tuning PCL Degradation

Evelyn Mikkelson - Mar 26, 2026, 12:33 PM CDT

Title: Tuning Polycaprolactone Degradation for Long Acting Implantables

Date: 2026/03/26

Content by: Evelyn Mikkelson

Search Term: Google: tunable PCL PLA degradation

Citation:

> W. R. Lykins, D. A. Bernards, E. B. Schlesinger, K. Wisniewski, and T. A. Desai, “Tuning polycaprolactone degradation for long acting implantables,” *Polymer*, vol. 262, p. 125473, Dec. 2022, doi: 10.1016/j.polymer.2022.125473.

Link: https://www.sciencedirect.com/science/article/pii/S0032386122009612

Goals: Look into the PCL and PLA blend someone mentioned at show and tell.

Content:

Polycaprolactone

- Bioresorbable polyester
- Bulk degradation
- PCL implants target 6 months to a year
  - Degradation if often years
- Can tune in selection of molecular weight
  - Limited sources
  - As molecular weight is decreased, it is crystalline and brittle
- PCL-PLA blends [19]
  - Faster hydrolysis and degradation by reactive oxygen species

Blending PCL Molecular Weights

- Binary or ternary molecular weight distributions to use low molecular weight PCL to decrease degradation time
- Permeability did not change with blended composition
- Low molecular weight PCL can blend up to 50% w/w with high molecular weight PCL and maintain mechanical properties

Conclusions, action items:

The timeline for degradation is still way too long for our application. I am going to try to find an article specifically with PLA/PCL blend.

Evelyn Mikkelson - Mar 26, 2026, 12:34 PM CDT

Polymer

Tuning polycaprolactone degradation for long acting implantables

William R. Lykins, Daniel A. Bernards, Erica B. Schlesinger, Ralizenbo Wierzbowski, Tejal A. Desai

ARTICLE INFO

ABSTRACT

1. Introduction

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2026/03/26 Biodegradable PLA/PCL Blends

Evelyn Mikkelson - Mar 26, 2026, 12:35 PM CDT

Title: Tuning Polycaprolactone Degradation for Long Acting Implantables

Date: 2026/03/26

Content by: Evelyn Mikkelson

Search Term: Google: tunable PCL PLA degradation

Citation:

> W. R. Lykins, D. A. Bernards, E. B. Schlesinger, K. Wisniewski, and T. A. Desai, “Tuning polycaprolactone degradation for long acting implantables,” *Polymer*, vol. 262, p. 125473, Dec. 2022, doi: 10.1016/j.polymer.2022.125473.

Link: https://www.sciencedirect.com/science/article/pii/S0032386122009612

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Conclusions, action items:

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2026/04/09 ASTM F1635-16

Evelyn Mikkelson - Apr 09, 2026, 12:36 PM CDT

Title: Standard Test Method for in vitro Degradation Testing of Hydrolytically Degradable Polymer Resins and Fabricated Forms in Surgical Implants

Date: 2026/04/09

Content by: Evelyn Mikkelson

Search Term: Google: degradation testing methods

Citation:

> ASTM International, *Standard Test Method for in vitro Degradation Testing of Hydrolytically Degradable Polymer Resins and Fabricated Forms for Surgical Implants*, F1635-24, Dec. 05, 2024. [Online]. Available: https://compass.astm.org/content-access?contentCode=ASTM%7CF1635-24%7Cen-US

Link: https://compass.astm.org/content-access?contentCode=ASTM%7CF1635-24%7Cen-US

Goals: See what we can do for degradation testing of materials.

Content:

Scope

- Hydrolytically degradable polymers for use in surgical implants
- Results no sufficient for predicting degradation of final, sterilized implant

Testing Methods

- Samples placed in solution at physiological pH and temperature
  - Samples periodically removed and tested
- Mechanically unloaded hydrolytic evaluation
  - Samples in soaking solution to get approximate degradation characteristics
  - Hydrolytic aging alone is not sufficient to fully characterize

Materials

- Phosphate buffered saline with pH maintained at 7.4 +/- 0.2, unless determined that it should be different
- Ionic concentration should be in physiologic range depending on application
  - 0.1M phosphate buffer and 0.1M NaCl for most tissue contacting
- pH of solution needs to be monitored frequently to ensure it is in acceptable range
- Sample container needs to allow proper surface area contact for all samples (if multiple)
- Constant temperature bath (or oven) needs to maintain 37 +/- 1 degC
- pH meter
- Balance to measure mass of samples

Sampling

- Mass loss - minimum three samples per time period

- Solution temperatures tested periodically
- Time intervals depending on sample

Sample and Test Specimen

- Recommended that samples containing variation in design be produced from same lot

Mass Loss Procedure

- Test samples weighed to a precision of 0.1% of total sample mass prior to being in solution
- Samples should be dried to constant mass prior to initial weighing
- Drying conditions should be noted and include use of vacuum or elevated temperatures
- Test samples shall be fully immersed for selected time
- When time is up, each sample is removed, gently rinsed with distilled water (remove salts), placed in container, and dried to constant mass
- Record weight to precision of 0.1% original total sample mass
- After weighing samples shall not be returned to solution and are retired from degradation study

Termination

- End testing after determined time, loss of sample integrity (due to degradation), or solution temperature or pH has drifted outside required ranges

Record Data

- Solution composition and preparation procedures
- Measurement of solution temperature and pH with time
- Sample mass as an average percent loss

Conclusions, action items:

Use this outline to make a procedure to test mass loss in our degradable material.

2026/01/26 Client Question Brainstorm

Evelyn Mikkelson - Jan 26, 2026, 5:26 PM CST

Title: Client Question Brainstorm

Date: 2026/01/26

Content by: Evelyn Mikkelson

Goals: Come up with some questions based on preliminary research to ask the client next week.

Content:

What are the current challenges when using an endoscope?

- You mentioned that it is currently too technical, what steps would you make easier?
- The video you sent over contained many methods, which one do you currently use?
    - What method should we adapt the device to?

Are you looking for an alternative to the endoscope or an attachment?

What is the budget?

- What supplies could you provide access to?

Do you want a device for a specific area or for widespread use?

What do you envision for the device?

Conclusions/action items:

Continue research and note here if I come up with any other questions for the client before the meeting next week Wednesday

2026/02/09 Initial Design Brainstorm

Evelyn Mikkelson - Feb 09, 2026, 12:36 PM CST

Title: Inital Design Brainstorm

Date: 2026/02/09

Content by: Evelyn Mikkelson

Goals: Write down some design ideas pertaining to the project to help with creation of design matrix.

Content:

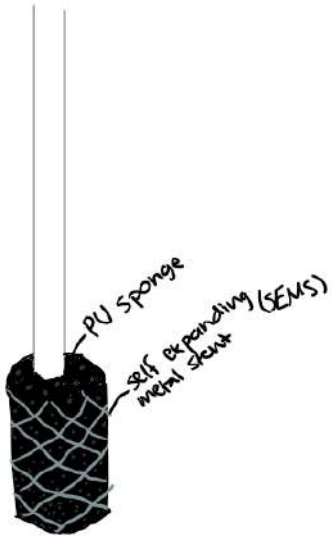


Figure 1. Surrounding the sponge with a self expanding metal stent so it is smaller going into the cavity and will expand to fit once placed.

Figure 2. A self expanding metal stent incorporated into the sponge. It could still control size while preventing interaction between tissue and stent.

Other Ideas

- Materials: drainage film
- Sponge: finding a way to make it expandable
- Placement: valve to temporarily employ suction to adhere to tissue?

Conclusions, action items:

Present this at the team meeting and come up with designs and criteria for the design matrix.

2026/02/11 Adaptation Current Products

Evelyn Mikkelson - Feb 11, 2026, 6:21 PM CST

Title: Adaptation of Current Endoscopy Accessories

Date: 2026/02/11

Content by: Evelyn Mikkelson

Goals: Brainstorm some more designs prior to team meeting.

Content:

Initial Thoughts

- Using a closure clip and attaching a sponge
- Having a way to "inflate" the sponge or material (balloon)
- Some sort of vacuum seal or folding

Clip

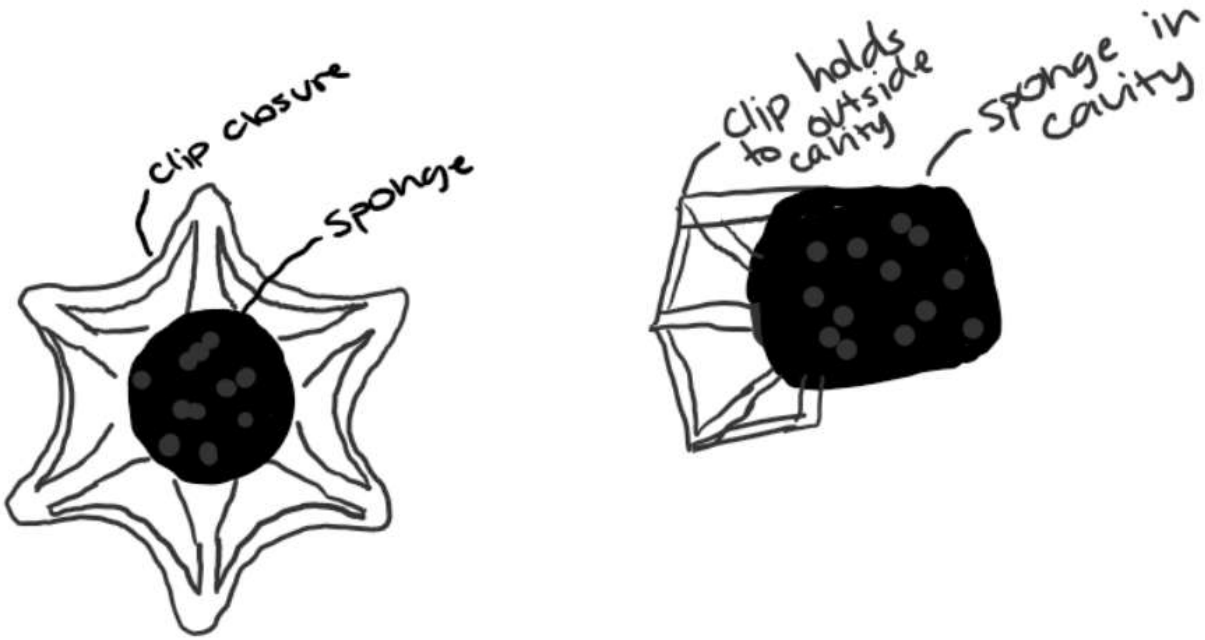


Figure 1. On the left is a front view of a clip with a sponge attached to the center and the right a side view. The aim was to have the outer edge outside the cavity and be able to hold the sponge inside the cavity.

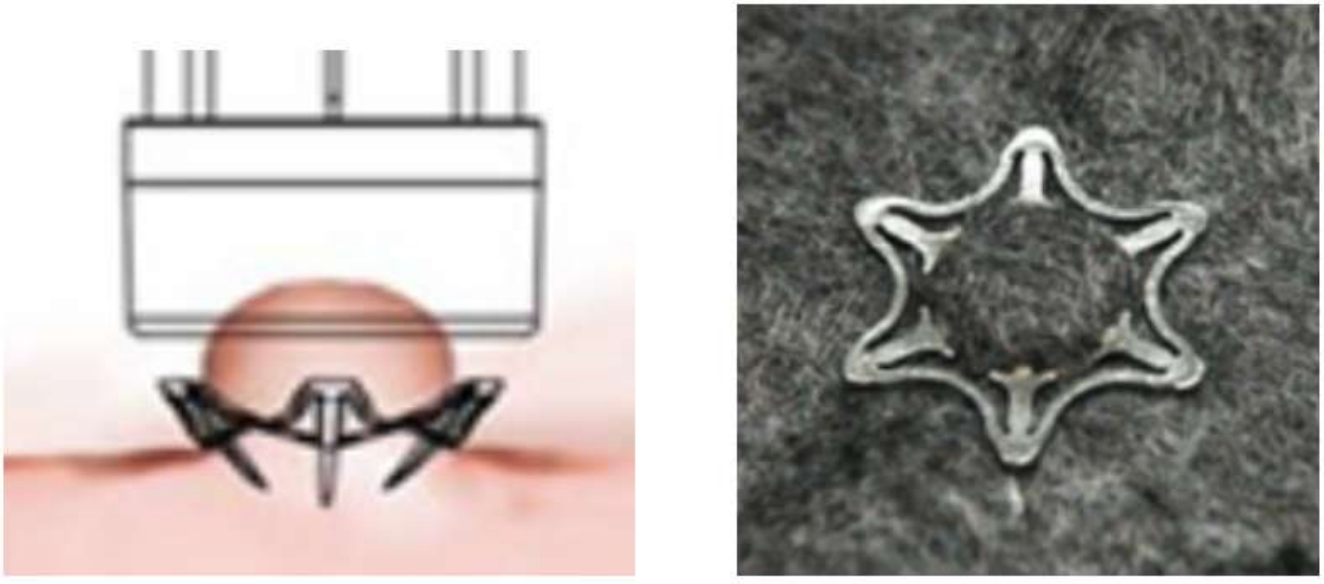


Figure 2. Images from Steris product page showing how the device is normally deployed for a better idea for how it could work.

Conclusions, action items:

Look at more devices and see if anything sticks.

2026/02/19 Design Matrix SolidWorks

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Title: SolidWorks

Date: 2026/02/19

Content by: Evelyn Mikkelson

Goals: Complete SolidWorks designs for use in the preliminary presentation

Content:

Components For Build

- Degradable Coating
  - Sponge before and sponge after
  - Coating
  - Tube
- Cap Delivery
  - Sponge before and after
  - Cap with loop for forceps
  - Tube

Degradable Coating Design

Figure 1. Initial image for presentation. Feedback was that it looks like a 201 biomaterial holder and that the colors should be changed. Also white backgrounds.

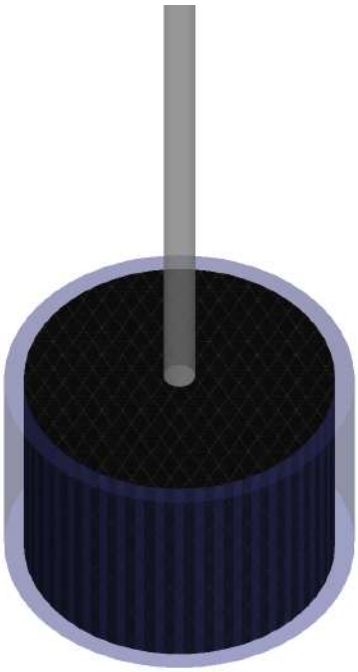


Figure 2. Degradable coating design before/during deployment.

Figure 3. Degradable coating design after deployment. There is no longer a coating and the sponge has expanded to size.

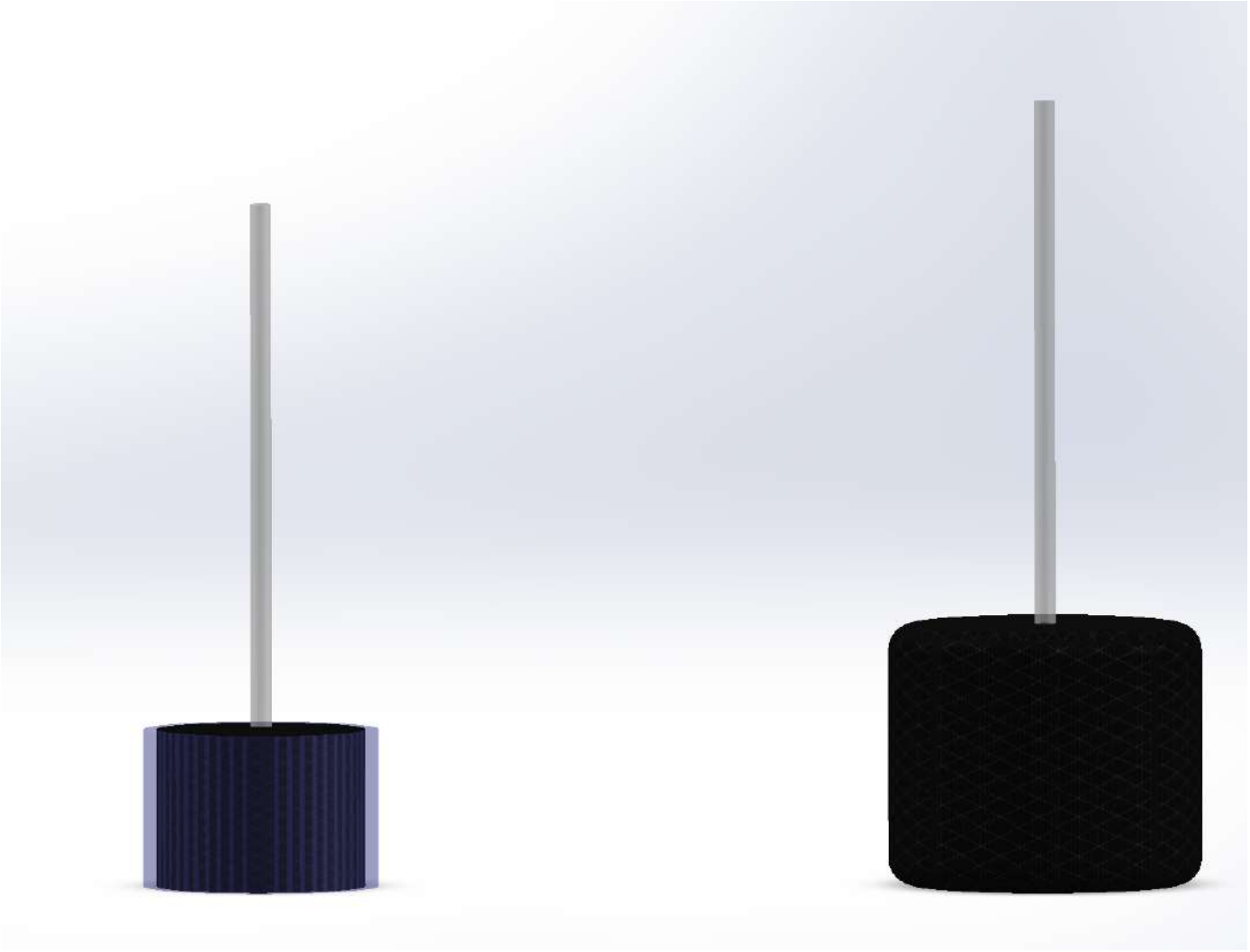


Figure 4. Degradable sponge before and after deployment side by side to show progression.

Cap Delivery Design

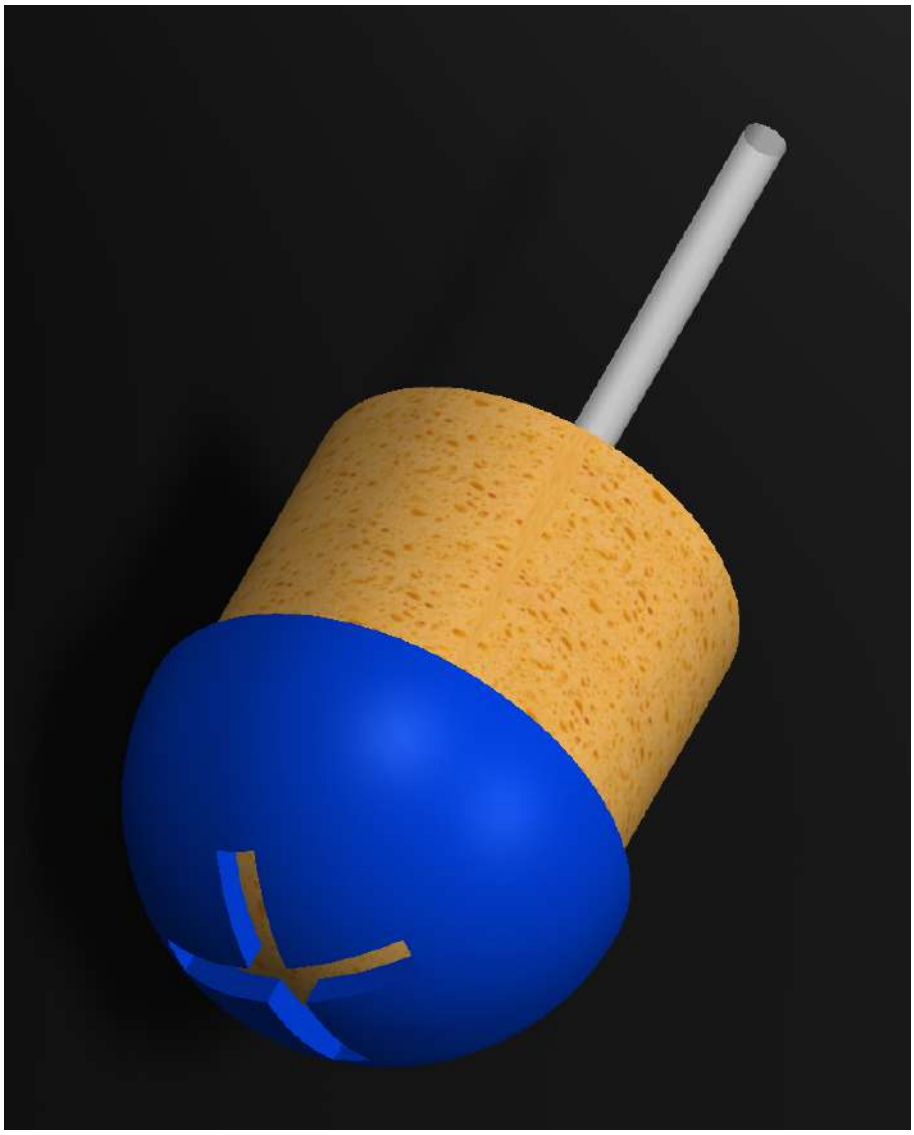


Figure 5. Initial image for presentation. Feedback was to make a before and after, change the color of the sponge. Also need to add loop, so it matches the drawing.

Figure 6. Cap delivery design before and after. Note from Yeanne that the cap on after should be flipped.

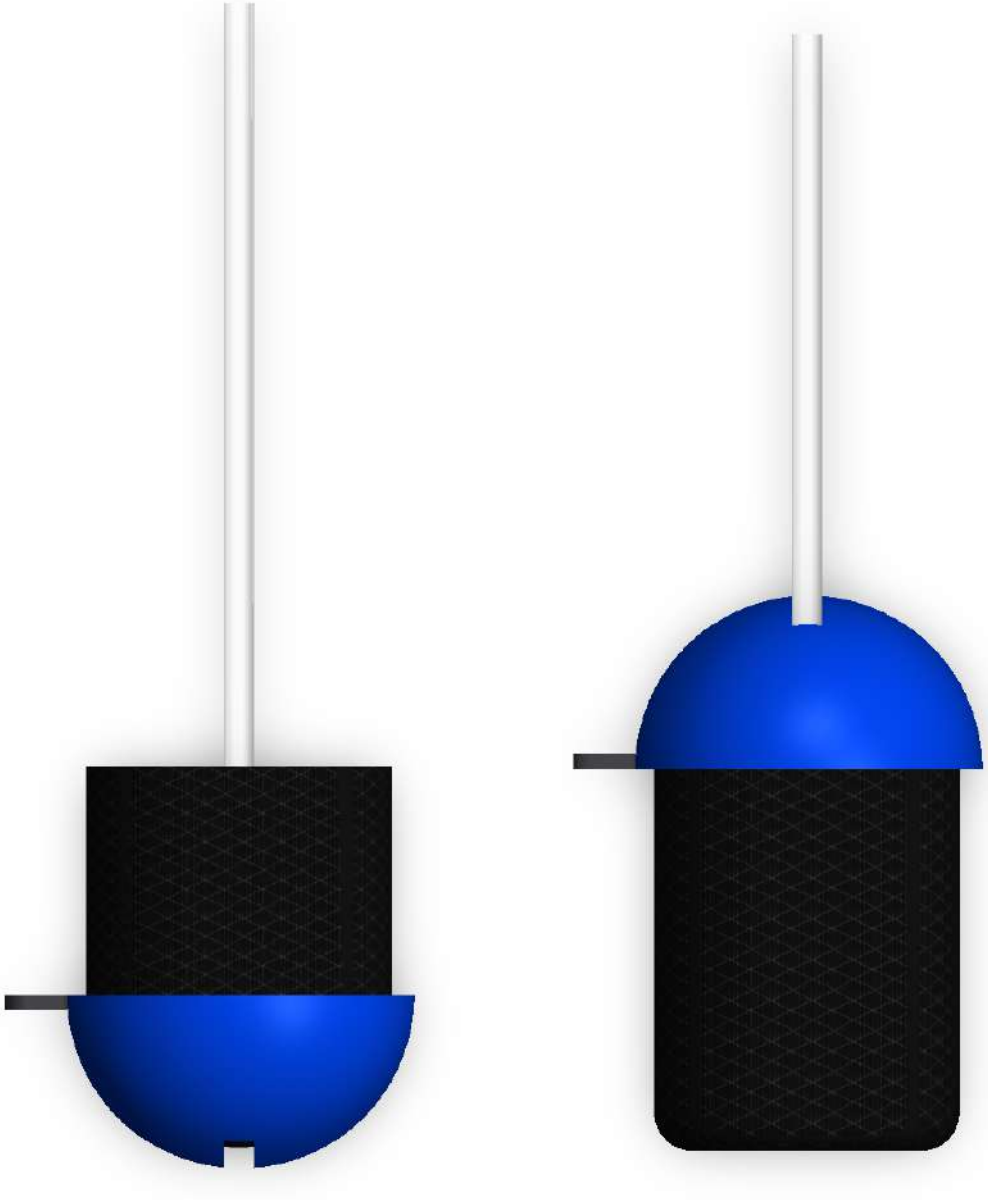


Figure 7. Cap delivery design with flipped cap. Yeanne said something about making second sponge bigger so see about that.

See below for all part/assembly SolidWorks files.

Conclusions, action items:

Make sure these are in the presentation with scale bars.

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

cap_design_before.SLDASM (220 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

sponge_for_cap_after.SLDPRT (201 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

covering.SLDPRT (220 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

sponge_for_cap_before.SLDPRT (381 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

coated_sponge_after.SLDASM (139 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

coated_sponge_both.SLDASM (113 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

sponge_for_coating_after.SLDPRT (201 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

coated_sponge_before.SLDASM (84.5 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:37 PM CST

Download

sponge_for_coating_before.SLDPRT (405 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:38 PM CST

Download

tube.SLDPRT (58.8 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:38 PM CST

Download

coating.SLDPRT (81.5 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:41 PM CST

Download

cap_design_both.SLDASM (262 kB)

Evelyn Mikkelson - Feb 19, 2026, 12:41 PM CST

Download

cap_design_after.SLDASM (221 kB)

2026/03/01 Materials

Evelyn Mikkelson - Mar 01, 2026, 4:58 PM CST

Title: Material Brainstorm

Date: 2026/03/01

Content by: Evelyn Mikkelson

Goals: Get down some ideas for materials choice.

Content:

Current Team Ideas

- Simon - plant pharma coating - concerned about it being water soluble (hydrolysis)
- Mariah - PEG - concern for strength, ability to hold seal

Combination

- Could we add plant coating to PEG?
  - Make it stronger
  - Allow the coating to be majority protease degradable
- Add other things?
  - I saw gelatin and PEG being used when scanning article
  - Would collagen be better if looking for structural properties?

Moving Forward

- If we have two groups each could have a different add in
  - Make one without PEG and one with to show there is a difference in degradation per group

Conclusions, action items:

Research these combinations to see what it would take to fabricate. Bring this up with team either over text before client meeting or during client meeting.

2026/03/25 PVA SolidWorks

Evelyn Mikkelson - Mar 25, 2026, 12:35 PM CDT

Title: PVA SolidWorks

Date: 2026/03/25

Content by: Evelyn Mikkelson

Goals: Make a stl file to print from if we are able to use PVA.

Content:

See file below.

Conclusions, action items:

Go to makerspace and see if we are able to make part from the structural PVA.

Evelyn Mikkelson - Mar 25, 2026, 12:37 PM CDT

Download

PVA_Coating.STL (16.5 kB)

Evelyn Mikkelson - Mar 25, 2026, 12:37 PM CDT

Download

PVA_Coating.SLDPRT (80.5 kB)

2025/01/28 Biosafety and Chemical Safety Training

Evelyn Mikkelson - Jan 28, 2025, 5:07 PM CST

Title: Biosafety and Chemical Safety Training

Date: 2025/01/28

Content by: Evelyn Mikkelson

Goals: Upload page that verifies I have completed the biosafety and chemical safety training.

Content:

I completed my biosafety/chemical safety training last semester during BME 200.

Conclusions/action items:

See attached for document verifying completion of training.

Evelyn Mikkelson - Jan 28, 2025, 5:07 PM CST

Download

Biosafety-Chemical_Safety_Training.pdf (42.2 kB)

2025/01/30 Intro To Machining Training

Evelyn Mikkelson - Jan 30, 2025, 9:25 AM CST

Title: Intro to Machining Training

Date: 2025/01/20

Content by: Evelyn Mikkelson

Goals: Upload proof of completion for Intro to Machining Training.

Content:

Successfully completed Intro to Machining test part last night.

Conclusions/action items:

See below for pdf of proof of membership to machining.

Evelyn Mikkelson - Jan 30, 2025, 9:25 AM CST

Download

MachiningTraining.pdf (221 kB)

2025/10/29 CITI Training

Evelyn Mikkelson - Oct 29, 2025, 6:45 PM CDT

Title: CITI Training

Date: 2025/10/29

Content by: Evelyn Mikkelson

Goals: Upload proof of completion for CITI training.

Content:

Successfully completed CITI training today.

Conclusions/action items:

I will upload proof of completion once the website refreshes.

Evelyn Mikkelson - Oct 30, 2025, 8:43 AM CDT

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Evelyn Mikkelson has completed training for the following course(s):

Course	Assignment	Completi
Biosafety Required Training	Biosafety Required Training Quiz 2024	10/30/2024
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/27/2024
Responsible and Ethical Conduct of Research (RECR)	RCR Certification	6/2/2025
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/29/2025

Date Last Imported: 10/30/2025 08:04 AM

Download

CITI_Training.pdf (50.9 kB)

2026/03/02 HIPAA Training

Evelyn Mikkelson - Mar 02, 2026, 5:01 PM CST

Title: HIPAA Training

Date: 2026/03/02

Content by: Evelyn Mikkelson

Goals: Upload proof of completion for HIPAA training.

Content:

Completed HIPAA training in February through Canvas.

Conclusions/action items:

See below for proof of completion.

Evelyn Mikkelson - Mar 02, 2026, 5:02 PM CST

WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

This certifies that Evelyn Mikkelson has completed training for the following course(s):

Course	Assignment	Complet
2025-2026 HIPAA Privacy & Security Training	2025-2026 HIPAA Privacy & Security Training	2/10/2026
Biosafety Required Training	Biosafety Required Training Quiz 2024	10/10/2024
Chemical Safety: The OSHA Lab Standard	Final Quiz	10/27/2024
Responsible and Ethical Conduct of Research (RECR)	RCR Certification	6/2/2025
UW Human Subjects Protections Course	Basic/Refresher Course - Human Subjects Research	10/29/2025

Date Last Imported: 03/02/2026 04:58 PM

Download

HIPAA_Training.pdf (55 kB)

2026/01/29 EVT: explanation

YEANNE HWANG - Jan 30, 2026, 1:37 AM CST

Title: Endoluminal Vacuum Therapy: How I Do It

Date: 2026/01/29

Content by: Yeanne Hwang

Search Term: Pubmed: Endoluminal vacuum

Citation:

[1]
S. G. Leeds, M. Mencio, E. Ontiveros, and M. A. Ward, “Endoluminal Vacuum Therapy: How I Do It,” *Journal of Gastrointestinal Surgery*, vol. 23, no. 5, pp. 1037–1043, Jan. 2019, doi: https://doi.org/10.1007/s11605-018-04082-z.

Goals: Learn more about VAC

Content:

- GI perforations and postoperative leaks are difficult to manage and are associated with high morbidity and mortality.
- Traditional management includes surgical diversion, primary repair, endoscopic clipping, and stenting, each with variable success and complication rates.
- Endoluminal vacuum therapy (EVAC) has emerged as an effective endoscopic option with high success in reducing morbidity and mortality.
- EVAC uses an endosponge connected to a nasogastric tube, placed endoscopically into a fistula or leak cavity to apply continuous negative pressure.
- The therapy facilitates source control, drainage, wound debridement, tissue reperfusion, and granulation, promoting closure of the defect.
- EVAC has been applied throughout the GI tract, including the esophagus, stomach, small bowel, and colorectum.
- Reported closure rates in this series were 95% in the esophagus, 83% in the stomach, 100% in the small bowel, and 60% in colorectal cases.
- Patient selection is critical; early endoscopic evaluation is required to define defect size, cavity characteristics, and contamination.
- Small perforations can be treated intraluminally, while very large defects (>3 cm) are difficult to manage due to limits on sponge size and sealing.
- EVAC relies on maintaining negative pressure; defects with atmospheric exposure often fail therapy.
- Earlier initiation of EVAC is associated with better outcomes; delays increase failure rates.
- Endosponge exchange is typically performed every 3–7 days to prevent clogging and excessive tissue ingrowth.
- Failure to show progressive debridement, revascularization, and contraction on serial endoscopy should prompt reassessment or surgical intervention.
- EVAC is most effective when incorporated into a broader treatment algorithm.

Conclusions/action items:

The VAC is secure theraphy than old methods of surgery, but we need to find a problem statement to improve it.

2026/01/29 Endoluminal leaks & EVT

YEANNE HWANG - Mar 13, 2026, 12:38 PM CDT

Title: Endoluminal leaks & EVT

Date: 2026/01/29

Content by: Yeanne Hwang

Search Term: Pubmed: Endoluminal vacuum

Citation: file attached

Goals: Learn more about VAC in gastrointestial leaks

Content:

- Endoluminal vacuum (E-Vac) therapy applies the same principles as external VAC therapy, including removal of infected secretions, reduction of edema, increased local perfusion, and promotion of granulation tissue formation.
- E-Vac therapy has been used successfully in Europe for esophageal and gastric leaks and perforations, with high closure rates and low mortality.
- In this study, E-Vac therapy was used to treat upper GI leaks and perforations in patients who failed prior surgical repair or were poor candidates for surgery or stent placement.
- The E-Vac system consisted of polyurethane foam attached to a nasogastric tube and connected to a vacuum device delivering continuous negative pressure.
- All E-Vac procedures were performed under general anesthesia with endoscopic confirmation of the defect and associated cavity.
- Cavities were explored, irrigated, and debrided endoscopically prior to foam placement.
- Foam placement was either extraluminal (within the cavity) or intraluminal (adjacent to the defect) depending on cavity size and progression of healing.
- Continuous negative pressure of 175 mmHg was used in all patients.
- Foam exchanges were required every 7 days due to secretion buildup, reduced suction efficiency, and tissue ingrowth.
- All six patients treated in this series achieved complete closure (100%) of their leak or perforation.
- Average duration of E-Vac therapy was 35.8 days, with an average of 7.2 foam changes per patient.
- No complications were directly attributable to E-Vac therapy, and no deaths occurred within 30 days of starting treatment.
- Earlier initiation of E-Vac therapy was associated with shorter treatment duration and improved outcomes.
- E-Vac therapy requires multiple endoscopic procedures and technically demanding foam placement due to the absence of an FDA-approved dedicated device.
- The authors conclude that E-Vac therapy is a promising treatment for upper GI leaks and perforations, warranting further prospective controlled studies.

Conclusions/action items:

EVAC helped close of upper gastrointenstial leaks with low morbidity.

YEANNE HWANG - Jan 30, 2026, 10:21 AM CST

The use of endoluminal vacuum (E-Vac) therapy in the management of upper gastrointestinal leaks and perforations

Abstract

Introduction Upper intestinal leaks and perforations are associated with high morbidity and mortality rates. Despite the growing experience using endoscopically placed stents, the treatment of these leaks and perforations remains a challenge. Endoluminal vacuum (E-Vac) therapy is a novel treatment that has been successfully used in Germany to treat upper gastrointestinal leaks and perforations. There currently are no reports on its use in the USA.

Methods E-Vac therapy was used to treat 11 patients with upper gastrointestinal leaks and perforations from September 2013 to September 2014. Five patients with leaks following sleeve gastrectomy were excluded from this study. A total of six patients were treated with E-Vac therapy; these included: (n = 2) iatrogenic esophageal perforations, (n = 1) iatrogenic esophageal and gastric perforations, (n = 1) iatrogenic gastric perforation, (n = 1) gastric staple line leak following a surgical repair of a transmural gastric ulcer perforation due to an invasive fungal infection. Four patients had failed an initial surgical repair prior to starting E-Vac therapy.

Results All six patients (100 %) had complete closure of their perforation or leak after an average of 35.8 days of E-Vac therapy requiring 7.2 different E-Vac changes. No deaths occurred in the 30 days following E-Vac therapy. One patient died following complete closure of his perforation and transfer to an acute care facility due to an unrelated complication. There were no complications directly related to the use of E-Vac therapy. Only one patient had any symptoms of dysphagia. This patient had severe dysphagia from an esophagogastric anastomotic stricture prior to her iatrogenic perforations. Following E-Vac therapy, her dysphagia had actually improved and she could now tolerate a soft diet.

Conclusions E-Vac therapy is a promising new method in the treatment of upper gastrointestinal leaks and perforations. Current successes need to be validated through future prospective controlled studies.

Keywords Endoscopy · Vacuum therapy · Esophagus · Gastric · Perforation · Leak

Laparoscopic foregut surgery is associated with a low risk (1–3.3 %) of an iatrogenic perforation of the stomach or esophagus [1–3]. However, the risk of perforation can increase significantly (15.6–31.2 %) in re-operative cases [3]. Most perforations are recognized and closed intra-operatively with minimal morbidity and mortality [3]. Patient morbidity and mortality significantly increase, though,

Download

EVT009-Smallwood-2016.pdf (694 kB)

2026/01/29: EVT success&failure cases

YEANNE HWANG - Jan 30, 2026, 10:35 AM CST

Title: EVT success&failure cases

Date: 2026/01/29

Content by: Yeanne Hwang

Search Term: Pubmed: Endoscopic vacuum therapy failure

Citation:

D. H. Jung, C. W. Huh, Y. W. Min, and J. C. Park, “Endoscopic vacuum therapy for the management of upper GI leaks and perforations: a multicenter retrospective study of factors associated with treatment failure (with video),” *Gastrointestinal Endoscopy*, vol. 95, no. 2, pp. 281–290, Feb. 2022, doi: https://doi.org/10.1016/j.gie.2021.09.018.

Goals: Find problems of it by learning cases of EVT GI leaks treatment failure

Content:

- success: EVT achieved clinical success in 70.6% of patients with upper GI leaks or perforations.
- Failure rate: Approximately 29% of patients experienced EVT failure despite treatment.
- Key factors for EVT failure
    - Neoadjuvant treatment (chemotherapy, radiotherapy, or chemoradiotherapy before surgery).
    - Intraluminal EVT placement, where the sponge is positioned directly on the defect rather than within an associated cavity.
- Treatment timing: EVT used as rescue therapy showed worse outcomes compared with use as primary therapy.
- Clinical consequences of failure
    - Patients in the EVT failure group had significantly lower overall survival than those with successful EVT.
    - Leakage-related deaths occurred only in the EVT failure group; no deaths were directly attributable to EVT itself.
- Post-treatment stenosis occurred in 18.5% of patients during follow-up

Conclusions/action items:

EVT failure is primarily associated with prior oncologic treatment and suboptimal sponge placement strategy, highlighting the need for clearer selection criteria and technique optimization.

2026/01/29: EVT failure causes

YEANNE HWANG - Jan 30, 2026, 10:58 AM CST

Title: EVT failure& causes

Date: 2026/01/29

Content by: Yeanne Hwang

Search Term: Pubmed: Endoscopic vacuum therapy failure

Citation:

D. T. H. de Moura, B. S. Hirsch, P. H. B. V. Ribas, S. Q. Silveira, H. G. Guedes, and A. M. Bestetti, “Endoscopic vacuum therapy: pitfalls, tips and tricks, insights, and perspectives,” *Translational gastroenterology and hepatology*, vol. 9, p. 50, Dec. 2024, doi: https://doi.org/10.21037/tgh-23-86.

Goals: Find problems of it by learning cases of EVT GI leaks treatment failure

Content:

failure cases

1) Can’t maintain negative pressure / system not functioning

Causes: leakage/air entry, obstruction/clogging, disconnection, full reservoir, pump/battery issues, sponge migration.

2) Wrong placement strategy

Paper flags intraluminal placement as an independent risk factor for failure in large studies.

3) Late initiation (delay from diagnosis → EVT start)

“Time to EVT” associated with failure in large studies.

4) Barrier: Frequent exchanges due to tissue ingrowth

OPPS requires multiple exchanges because of tissue ingrowth; increases procedure burden and AE risk.

5) Barrier: Access & size constraints → difficult placement/removal

Large diameter sponge systems are harder to pass and manipulate; placement/removal time increases.

6) External drains and cutaneous openings break negative pressure

If percutaneous drain communicates with the cavity, it must be removed/capped; skin orifice may need occlusion.

* Risks: Major bleeding risk (rare but severe)

Major bleeding reported- concern for vascular fistula/pseudoaneurysm in upper GI TGIDs.

* Stricture after EVT

Association with prolonged intraluminal OPPS in some contexts.

Conclusions/action items:

While this paper focus on vesicular EVT failure, it provides clear insight into practical and technical problems in current EVT systems, which can be used to idea of improvement.

2026/02/11:Characteristics of Polycarbonate

YEANNE HWANG - Feb 13, 2026, 11:55 AM CST

Title: Characteristics of Polycarbonate

Date: 2026/02/11

Content by: Yeanne Hwang

Search Term: Pubmed: Biodegration polyurethane

Citation:

D. Powell, “Medical Applications of Polycarbonate,” *www.mddionline.com*, Sep. 01, 1998. https://www.mddionline.com/product-development/medical-applications-of-polycarbonate

Goals: find best biocompatible material for cap design

Content:

Topic: Polycarbonate (PC) has combination of characteristics and strengths

- High strength & toughness
    - Tough enough to make thin wall cap.
- Optical clarity is high
    - Easy to check sponge placement in EVT, able to visual monitoring the leakage cavity
- Low water absorption
- Sterilization compatibility (EtO, Gamma radiation, Electron beam irradiation, steam autoclave...)
- Biocompatibility (ISO 10993-1, USP Class VI compliant grades available)

Manufacturing Techniques

- Injection molding
- blow molding
- extrusion to make film, sheet ...
- thermoforming
- machining

Medical Applications

- Renal Diasis : protect fragile dialysis while allwing visual monitoring
- Cardiac surgery products
- IV connector

Medical Grade Development

- High temperature grades : withstand flash autoclaving (~270F).
- Lipid resistant : Standard PC can have stress craking when exposed to lipid emulsion, but specialized grades improve resistance.
    - PC+Polyester blends : enhance chemical resistnace
    - Gastric acid (pH 1–3) -> testing required

Conclusions/action items:

Need further research of the lipid resistant anc different grades of PC

2026/02/11: Biodegration of Polyurethane

YEANNE HWANG - Feb 13, 2026, 11:56 AM CST

Title: Biodegration of Polyurethane

Date: 2026/02/11

Content by: Yeanne Hwang

Search Term: Pubmed: Biodegration polyurethane

Citation:

[2]
T. M. Sinclair, C. L. Kerrigan, and R. Buntic, “Biodegradation of the polyurethane foam covering of breast implants,” *Plastic and reconstructive surgery*, vol. 92, no. 6, pp. 1003–13; discussion 1014, Nov. 1993, Available: https://pubmed.ncbi.nlm.nih.gov/8234496/

Goals: find best biocompatible material for cap design

Content:

Topic: biodegradation of polyurethane foam in body(case of surface covering on breast implants

- polyurethane coated implants are known to reduce incidence of capsular contracture
- Total of 75 polyurethane-covered breast implants retrieved from 47 patients were analyzed
    - Researchers used
        - **Scanning Electron Microscopy (SEM)** to evaluate structural damage and measure foam strut thickness
        - **Fourier Transform Infrared (FTIR) spectroscopy and X-ray Photoelectron Spectroscopy (XPS)** to assess chemical composition
        - **Light microscopy** to examine residual foam within capsule tissue
    - explant background
        - 48% removed due to capsular contracture
        - 13% removed due to infection or prosthesis exposure
        - 39% removed for other reasons
- Key Findings
    - Progressive Degradation
        - Recovery of visibly intact foam decreased as implantation time increased.
    - Structural Damage
        - showed fractures, fissures, and thinning of polyurethane laayer
    - Reduction in Strut Width
        - Unimplanted foam: 49 ± 1.5 µm
        - Capsular contracture implants: 30 ± 3.1 µm
        - Infected implants: 32 ± 3.1 µm
- Residual Polyurethane in Capsule
    - Even when intact foam could not be recovered, microscopy found remaining polyurethane fragments in capsule tissue.

Conclusions/action items:

This paper gives strong evidence that polyurethane foam degrades structurally in human body. Further research regards other biocompatible material is needed.

2026/02/12: Medical graded PEEK (Polyetheretherketone)

YEANNE H

Title: Medical graded PEEK (Polyetheretherketone)

Date: 2026/02/12

Content by: Yeanne Hwang

Search Term: Pubmed: Medical graded material

Citation:

[4]"PEEK (Polyetheretherketone) - Fluoropolymers / Alfa Chemistry," Alfa-chemistry.com, Sep. 14, 2023. https://fluoropolymers.alfa-chemistry.com/products/peek-polyetheretherketone.html?gad_source=1&gad_campaignid=21278760611&gbraid=0AAAAA9sasiluEJOZ1Lw147sCH4x5TP4zC&gclid=CjwKCAiAtLvMBhB_EiwA1u6_Pp0O5B0VK6pkVMUMAp59YVuitB0vvyTNFpyd0v48

Goals: find best biocompatible material for cap design

Content:

Topic: TECAPEEK MT (Medical-Grade PEEK)

- High mechanical strength
- High thermal stability
- Excellent chemical resistance
- Strong sterilization resistance
- Long-term dimensional stability

Biocompatibility

- ISO 10993-1, -4, -5, -18 (for up to 24-hour skin/tissue contact and indirect blood contact)
    - need further research about long-term contact
- Tested according to ISO 10993
- Semi-finished products tested per USP Class VI (for certain grades)
    - ISO 10993-5 testing is conducted on semi-finished products on a batch basis

Steam Sterilization

- No significant loss of mechanical properties after 1,500 steam sterilization cycles
    - Compare to other materials :
        - PP-HT: ~1,000 cycles
        - POM-C: ~300–400 cycles
    - Sterilization test conditions
        - 134°C
        - 10-minute sterilization time
        - 20-minute drying time
        - 3 bar chamber pressur

Conclusions/action items:

This material has high steam sterilization resistivity in high temperature and tested under ISO 10993, but it lacks of numerical value and evidence of compatibility in esophagal environment (acid

2026/03/4 PVA-Gelatin Hydrogel

YEANNE HWANG - Mar 06, 2026, 1:45 PM CST

Title: PVA-Gelatin Hydrogel

Date: 2026/3/04

Content by: Yeanne Hwang

Search Term: Pubmed: PVA Gelatine

Citation:

https://pmc.ncbi.nlm.nih.gov/articles/PMC6387851/

Goals: find best biocompatible material for cap design

Content:

- PVA–gelatin hydrogels using a combination **of theta-gel and cryo-gel processing**, called PVA-gelatin theta-cryo-gels (TC-gels).
- PVA : main synthetic polymer
- gelatin (1% w/v) is added to improve toughness and bioactivity
- PEG (400 Da) is used as a temporary porogen to create pores and enhance PVA crystallinity.

How they fabricated

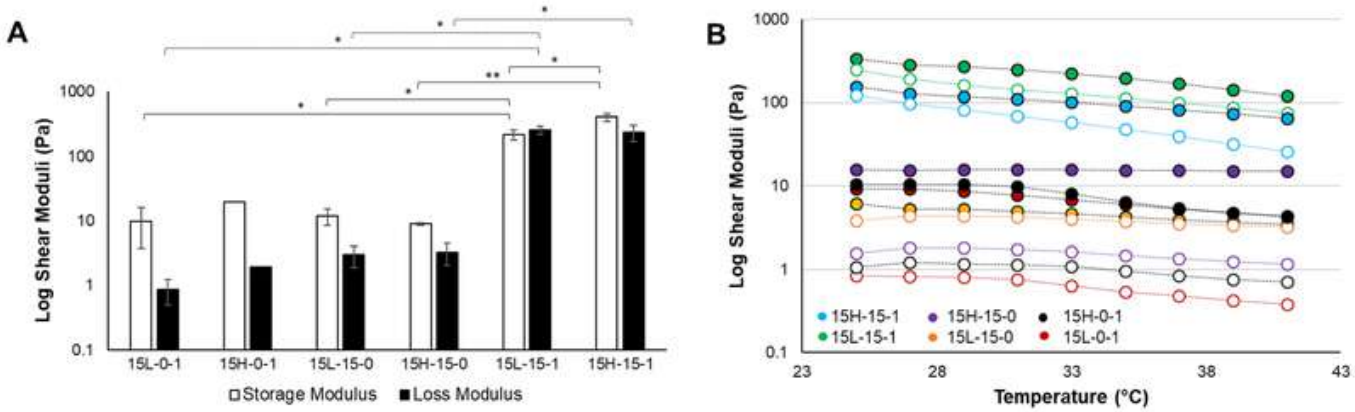
- Solutions of 15% PVA, 15% PEG, and 0 or 1% gelatin were blended at 105 °C until homogeneous, cast into molds, then cooled at room temperature to form theta-gels (phase separation with PEG).
- The theta-gels were then frozen at −20 °C (cryo-gel step), thawed, and dialyzed for 3 days to remove PEG, giving porous PVA–gelatin theta-cryo-gels.

Structure

- SEM showed macro-porous, semi-crystalline PVA networks
- ATR-FTIR indicated increased H-bond when gelatin was present
    - **PVA and gelatin form additional physical hydrogen bond**s, cause higher stiffness.
- PEG + gelatin ↓ swell ratio
    - Associated with higher crystallinity and more organized polymer networks.

Mechanical result

- Shear rheology:
    - TC-gels with PVA 15% + PEG 15% + gelatin 1% (15-15-1) = highest shear storage modulus
    - PVA molecular weight had minor influence compared with processing (theta+cryo) and the presence of gelatin.
    - Gels with gelatin softened as temperature rose from 25 → 41 °C => can be useful for insertion



Samples containing gelatin showed significant decrease in modulus as temperature increased

- Tensile tests
  - PVA+gelatin had higher Young's modulus than PVA-only (≈280 Pa vs ≈180 Pa)
  - similar high elongation (>90% strain to failure).
- Compression tests:
  - Compressive modulus rang
  - ~0.7 kPa → ~43 kPa depending on composition.

    PVA + gelatin (no PEG

    Highest stiffness

    PVA + PEG + gelatin (15-15-1)

    Strongest with high-MW PVA.
  - Key trend
    - PEG + gelatin → most structured and stiff networks.

Conclusions/action items:

Theta-gel + cryo-gel processing + PEG porogen + ~1% gelatin produces stiff, tough, resilient PVA hydrogels.

2026/03/4 Alginate Hydrogel

YEANNE HWANG - Mar 06, 2026, 1:47 PM CST

Title: Alginate Hydrogel

Date: 2026/3/04

Content by: Yeanne Hwang

Search Term: Pubmed: Hydrogel

Citation:

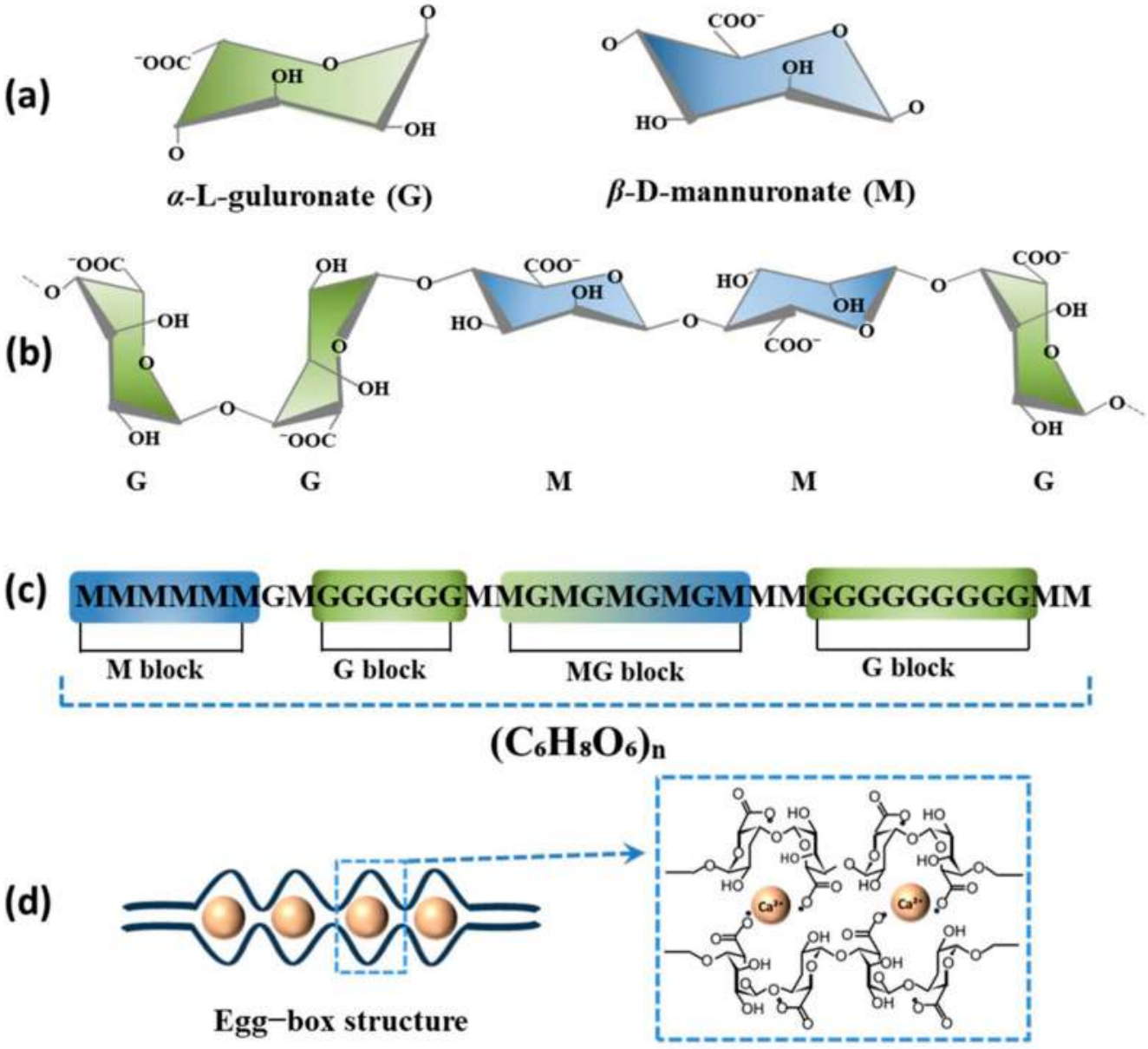
https://pmc.ncbi.nlm.nih.gov/articles/PMC12940349/

Goals: find best biocompatible material for coating

Content:

alginate

Biocompatible, biodegradable, hydrophilic, and non-toxic, which makes it attractive for in vivo use.



Forms hydrogels easily by ionic crosslinking with multivalent cations (e.g., Ca^{2+}), but **native alginate gels can be brittle and weak and have uncontrolled degradation**

Strategies to tune alginate hydrogel

- Ionic crosslinking control
  - Varying ion type (Ca^{2+}, Ba^{2+}, etc.), ion concentration, and crosslinking conditions
    - better stiffness, porosity, and stability.

Ionic	G-Block Binding Affinity	Crosslink Density	G' Modulus (Pa)	Yield Stress	Mechanical Robustness
Ca^{2+}	Moderate	Moderate	~0.02–0.03	Moderate	Good gel-like behavior
Mg^{2+}	Moderate–High	Enhanced (ADA-GEL-1.0 Mg)	--	--	33.9 ± 3.7 kPa (Compressive modulus)
Sr^{2+}	High	High	~0.04–0.05	Low	Excellent gel structure
Ba^{2+}	Very High	Very High	~0.08–0.10	Lowest	Superior rigidity; dominant elastic behavior
Cu^{2+}	Moderate–High	0.070–0.18 mol/cm^3	0.4–2.5 MPa	1200–3500	Enhanced mechanical strength;
Zn^{2+}	Moderate	0.060–0.13 mol/cm^3	0.2–1.5 MPa	1200–3800	Moderate enhancement; lower binding affinity than Ba^{2+}
Fe^{3+}	Extremely High	Very High (Rapid)	~0.02–0.03	None observed	Poor homogeneity
La^{3+}	Very High	High (Rapid)	~0.10–0.15	Low	Highest energy storage
Cs^{+}	None		G'' >> G'	None	No hydrogel formation

- Covalent crosslinking and chemical modification
  - Oxidation, methacrylation, and other chemical changes allow photo-crosslinking or dual crosslinking
    - improve mechanical strength and shape stability.
- Blends and composite systems
  - Combining **alginate** with **PVA, PVP, gelatin, chitosan, or synthetic polymers**
    - interpenetrating networks with better toughness, adhesion, or controlled swelling.
  - triple polymer hydrogel + PVA:PVP:sodium alginate = 10:6:1
    - showed high swelling (~325%)

Conclusions/action items:

Mixing alginate with PVA or PVP /crosslinking can make soft but robust and adhesive hydrogels with tunable swelling degradation, which can be used as films that goes in body

2026/03/11 Mixing HA+PLA

YEANNE HWANG - Mar 11, 2026, 1:24 PM CDT

Title: Mixing HA+PLA

Date: 2026/3/11

Content by: Yeanne Hwang

Search Term: Pubmed: Hyaluronic acid PLLA

Citation:

https://patents.google.com/patent/KR101852127B1/en

Goals: find best biocompatible material for coating

Content:

Combine PLLA (poly-L-lactic acid) and HA (hyaluronic acid) dermal fillers

- Mix cross-linked HA gel with PLLA particles
- PLLA stimulates collagen formation over time
- HA viscosity helps disperse PLLA evenly

Protocol

1. PLLA Preparation

- Mix PLLA + CMC + mannitol
- Freeze-dry (lyophilize)
    - −60 to −100 °C freezing
    - 15–25 °C drying for 5–10 days
- Pulverize particles to 30–100 μm
- Place in vial + gamma sterilization

2. HA Preparation

- Mix HA + BDDE cross-linker
- Form cross-linked HA gel
- Wash with phosphate buffer (30–80 L per 100 g HA)
- Filter through 80–120 mesh for uniform particles
- Fill into vial + autoclave sterilization

3. Final Mixing

- Mix HA with distilled water
    - Face: 15–25 cc water per 10 cc HA
    - Body: 25–35 cc water per 10 cc HA
- Inject HA mixture into PLLA vial
- Shake 3–8 minutes

- Load into syringe for injection

Conclusions/action items:

Recipe to mix HA + PLLA

2026/03/11 TGase+Glycerol + Gelatin

YEANNE HWANG - Mar 13, 2026, 1:12 PM CDT

Title: TGase+Glycerol + Gelatin

Date: 2026/3/11

Content by: Yeanne Hwang

Search Term: Pubmed: Gelatin cross linking

Citation:

https://www-sciencedirect-com.ezproxy.library.wisc.edu/science/article/pii/S0268005X16305240

Goals: find best biocompatible material for coating

Content:

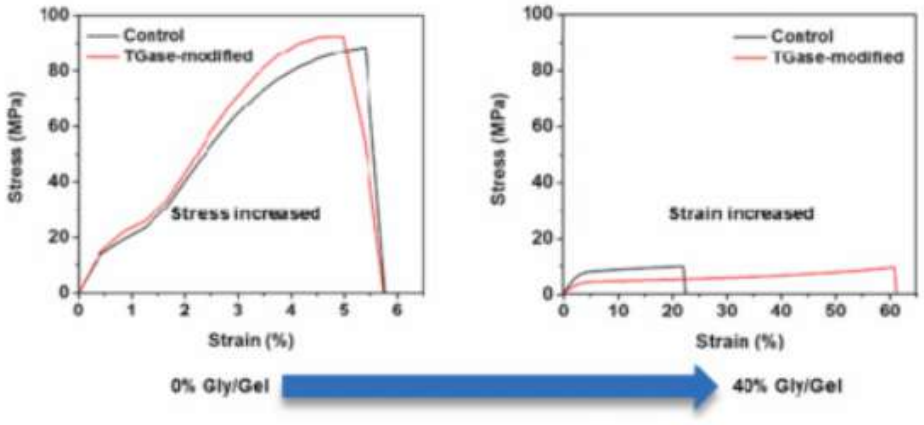
1. Role of Glycerol

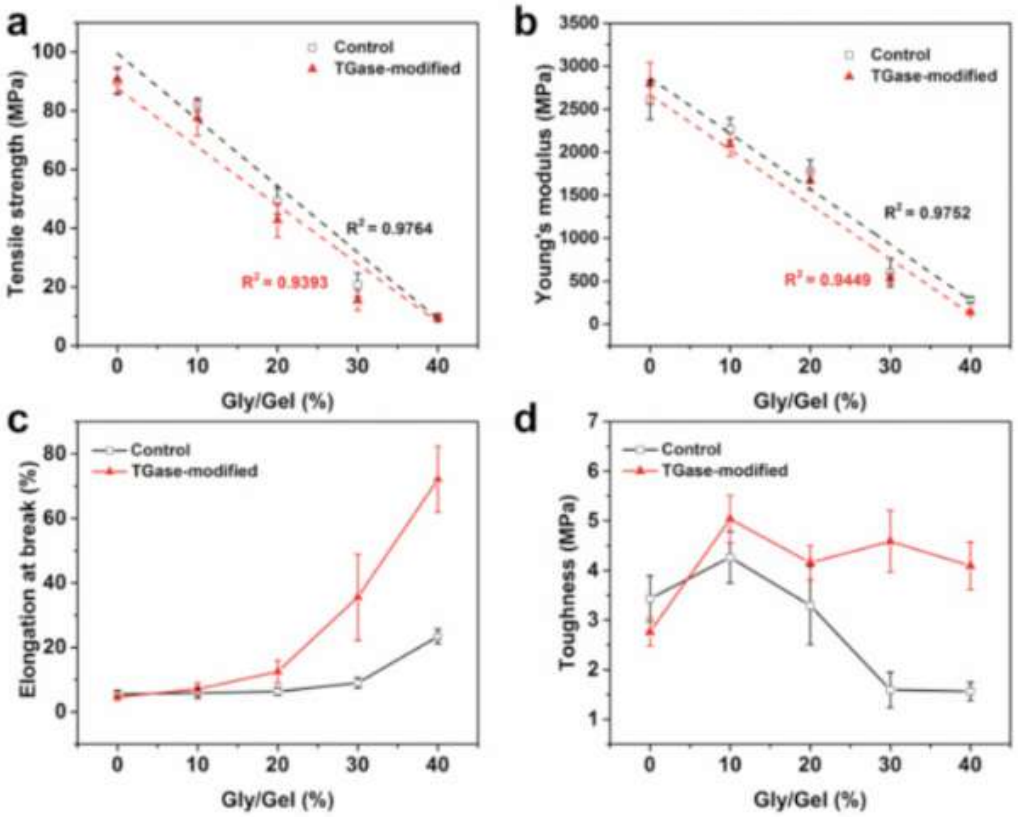
- It reduces intermolecular interactions between gelatin chains, increasing chain mobility.
- Glycerol molecules insert between polymer chains=> increase free volume within the matrix.
- Get greater flexibility, extensibility, and ductility of gelatin films.
- Functional properties of gelatin films strongly depend on glycerol concentration.

2. Effect of Glycerol on Cross-Linking (transglutaminase (TGase) Interaction)

- Increasing glycerol content linearly decreases the cross-linking degree of TGase-modified films.
- Cross-linking degree:
    - 87.3% at 0% glycerol
    - 56.5% at 40% glycerol
- Glycerol inhibits TGase cross-linking because it:
    - Forms hydrogen bonds with gelatin chains
    - Reduces accessibility of reactive sites (lysine and glutamine residues).
        - Lower molecular weight network
        - Higher solubility in water.

3. Mechanical Properties





Tensile Strength

- Tensile strength decreases linearly with increasing glycerol content.
- Mechanism:
  - Plasticizer reduces intermolecular forces
  - Lower resistance to fracture.

Young's Modulus (Film Stiffness)

- Young's modulus decreases significantly as glycerol increases.
- Observed decrease:
  - ~2700 MPa → ~200 MPa.
- Explanation:
  - Increased chain mobility
  - Reduced intermolecular cohesion

Elongation at Break

- TGase-modified films showed
  - 294% increase in elongation at break at 30% glycerol.

Toughness

- Toughness increases with glycerol up to ~30%.
- Maximum toughness improvement:
  - 187% increase at 30% glycerol.
- At 40% glycerol, toughness decreases slightly due to reduced cross-linking.

4. Moisture Content

- Moisture content increases with glycerol concentration.
- Higher water uptake
- Greater film flexibility.

5. Film Thickness

- Film thickness increases linearly with glycerol content.

6. Water Solubility

- Water solubility increases with glycerol content.

2026/03/11 Mechanical testing for Gelatin+PEG/Glycerol

YEANNE HWANG - Mar 13, 2026, 1:12 PM CDT

Title: Mechanical testing for Gelatin+PEG/Glycerol

Date: 2026/3/11

Content by: Yeanne Hwang

Search Term: Gelatin Glycerol

Citation:

https://emerginginvestigators.org/articles/23-139

Goals: find best biocompatible material for coating

Content:

Investigate how two plasticizers(glycerol and polyethylene glycol (PEG)) affect the mechanical and chemical properties of gelatin films

Experimental Design

- Plasticizers tested
  - PEG (1%, 2%, 3% w/v)
  - Glycerol (1%, 2%, 3% w/v)

Experiments performed:

1. Mechanical testing
   - Tensile strength (TS)
   - Elongation at break (EAB)
2. Chemical analysis
   - FTIR to analyze hydrogen bonding (O–H bonds)
3. Biocompatibility test
   - Cytotoxicity (MTT assay)

Mechanical Properties

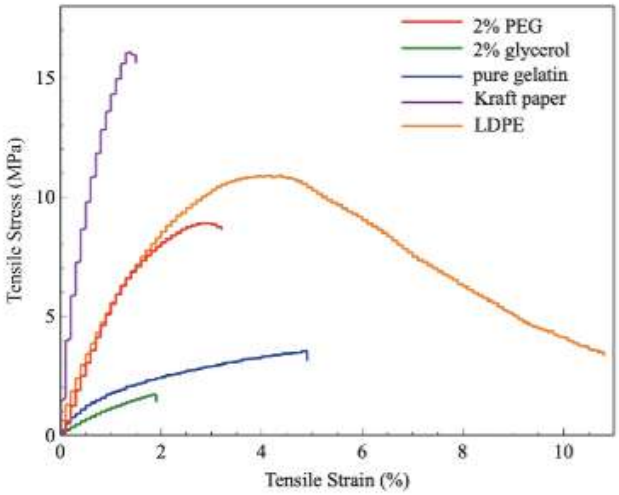
Tensile Strength (TS)

- PEG increased tensile strength as concentration increased
  - Up to 10.30 MPa at 3% PEG.
- Glycerol decreased tensile strength
  - Down to 1.44 MPa at 3% glycerol.

https://doi.org/10.5972/23-139

Type of plastic	Thickness (mm)	Tensile Strength (MPa)	Elongation at break (%)
pure gelatin	0.185 ± 0.0137	3.65 ± 0.115	4.87 ± 0.161
1% w/v PEG	0.101 ± 0.00216	2.32 ± 0.0918	0.56 ± 0.0573
2% w/v PEG	0.174 ± 0.030	7.58 ± 1.09	4.00 ± 0.649
3% w/v PEG	0.132 ± 0.00939	10.30 ± 1.22	4.10 ± 0.278
1% w/v glycerol	0.274 ± 0.00141	7.30 ± 0.0735	1.70 ± 0.376
2% w/v glycerol	0.390 ± 0.167	1.69 ± 0.0896	1.73 ± 0.417
3% w/v glycerol	0.557 ± 0.0328	1.44 ± 0.122	3.18 ± 0.646

Table 1: Mechanical properties of gelatin films (n=3). Average values for the thickness, TS, and elongation at break of different biofilms. Uncertainties were derived from the standard deviation taken to three significant figures following the mean.



- Glycerol disrupts polymer-polymer interactions.
- PEG improves load resistance in the film matrix

Cytotoxicity

- Cell viability results:
  - Pure gelatin: 96.3%
  - PEG film: 84.1%
  - Glycerol film: 88.5%

2026/03/15 Degradation of Alginate Based on Crosslinks

YEANNE HWANG - Mar 13, 2026, 1:35 PM CDT

Title: Mechanical testing for Gelatin+PEG/Glycerol

Date: 2026/3/11

Content by: Yeanne Hwang

Search Term: Gelatin Glycerol

Citation:

https://emerginginvestigators.org/articles/23-139

Goals: find best biocompatible material for coating

2026/04/02 Alginate, Gelatin, and Hyaluronic Acid

YEANNE HWANG - Apr 29, 2026, 1:58 AM CDT

Title: combining Alginate, Gelatin, and Hyaluronic Acid

Date: 2026/4/2

Content by: Yeanne Hwang

Citation:

[1]
A. Serafin, M. Culebras, and M. N. Collins, “Synthesis and evaluation of alginate, gelatin, and hyaluronic acid hybrid hydrogels for tissue engineering applications,” *International Journal of Biological Macromolecules*, vol. 233, p. 123438, Apr. 2023, doi: https://doi.org/10.1016/j.ijbiomac.2023.123438.

Contents:

1. Key Materials & Characteristics

- Alginate: High biocompatibility and low cost. Easily cross-linked via Ca2+ ions but lacks cell-binding sites, which can limit cellular attachment.
- Hyaluronic Acid (HA): A natural component of the ECM. It has high water retention and plays a role in cell signaling, though it requires cross-linking due to poor mechanical stability.
- Gelatin: A collagen derivative that provides excellent cell-adhesive motifs (like RGD sequences), promoting better cell attachment and proliferation than alginate or HA alone.

2. Research Objective

- To investigate how different concentrations and combinations of these biomaterials affect physicochemical properties.
- To provide a rational approach for selecting the right material for specific targeted TE strategies (e.g., bone, cardiac, or neural repair).

3. Key Findings & Data

- Mechanical Strength: Increasing concentrations of Alginate and Gelatin generally increased the Young's Modulus. Adding HA tended to decrease the Modulus.
- Swelling & Degradation: Alginate/Gelatin: Showed rapid swelling and completely dissolved in PBS within 24 hours due to the reversible nature of ionic cross-linking.
    - Gelatin/HA: Displayed long-term stability (over 168 hours) when chemically cross-linked with EDC/NHS.
- Porosity: Pore sizes generally ranged between 100–500 μm, which is considered optimal for nutrient exchange and cellular migration.
- Biocompatibility: All tested hydrogel groups were non-cytotoxic to NIH/3T3 fibroblasts. Gelatin-containing blends showed the best cell proliferation

2026/04/20 degradation rate of genipin cross-linked gelatin

YEANNE HWANG - Apr 29, 2026, 10:19 PM CDT

Title: degradation rate of genipin cross-linked gelatin

Date: 2026/4/20

Content by: Yeanne Hwang

Citation:

[2]
E. Entekhabi, M. Haghbin Nazarpak, M. Sedighi, and A. Kazemzadeh, “Predicting degradation rate of genipin cross-linked gelatin scaffolds with machine learning,” *Materials Science and Engineering: C*, vol. 107, p. 110362, Oct. 2019, doi: https://doi.org/10.1016/j.msec.2019.110362.

Contents:

- Materials and Fabrication: Porous scaffolds were prepared using different weight percentages of gelatin (2.5%, 5%, 10%) and genipin (0.125% to 1%) through a freeze-drying method.
- Characterization: Microstructure was analyzed via SEM, and tests were conducted for swelling behavior, tensile strength, and degree of crosslinking.
- Degradation Study: Actual degradation data were collected by immersing samples in PBS solution for periods ranging from 3 to 28 days.

Major Findings

- Effect of Genipin: Higher genipin content increased the degree of crosslinking, improving ultimate tensile strength (UTS) by up to 113%. Conversely, the degradation rate decreased significantly (average of 124%).
- Correlations: Factors such as pore size, swelling behavior, and mechanical strength showed strong correlations with the degradation rate.

Machine Learning Performance

The study compared two models to predict the degradation rate based on experimental data:

- Artificial Neural Networks (ANN): Demonstrated higher accuracy with a Mean Squared Error (MSE) of 2.68%.
- Kernel Ridge Regression (KRR): Recorded an MSE of 4.78%.

Conclusion

The use of machine learning models can significantly reduce the experimental costs and time required for scaffold design. The study highlights the high potential of data-driven approaches in biomedical engineering.

2026/02/03: EsoSponge Therapy Cases

YEANNE HWANG - Feb 06, 2026, 12:19 PM CST

Title: EsoSponge Cases

Date: 2026/02/2

Content by: Yeanne Hwang

Search Term: Pubmed: EsoSponge

Citation:

[6]L. F. Z. Radaelli, B. Aramini, A. Ciarrocchi, S. Sanna, D. Argnani, and F. Stella, “The Success of Eso-SPONGE® Therapy in the Treatment of Anastomotic Dehiscence after Ivor-Lewis Subtotal esophagectomy: a Case Report,” International Journal of Surgery Case Reports, vol. 88, p. 106525, Nov. 2021, doi: https://doi.org/10.1016/j.ijscr.2021.106525.

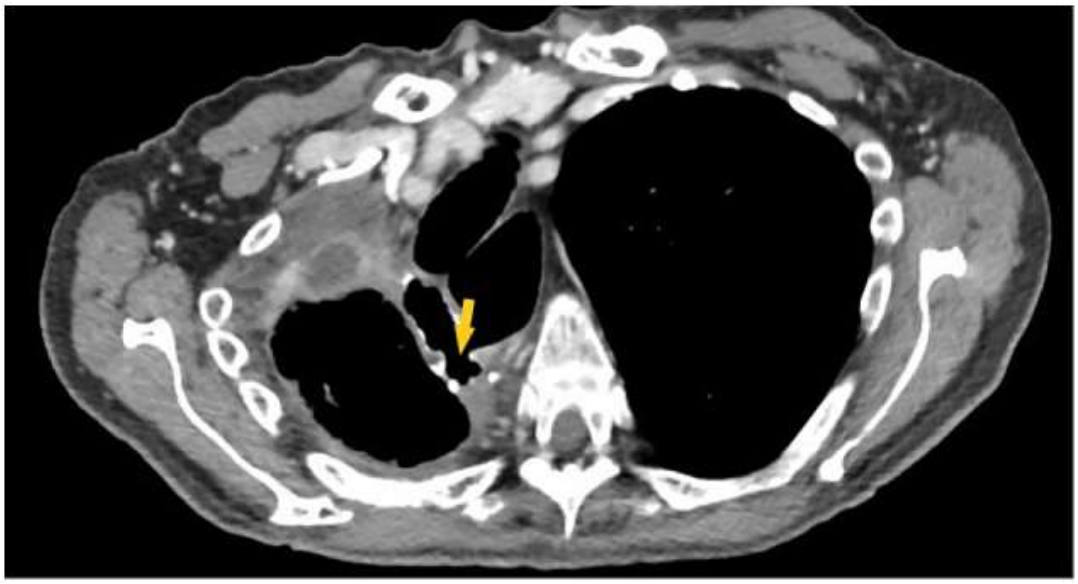
Goals: Find problems of it by learning cases of EVT GI leaks treatment failure

Content:

Cases 1

(72Y/underwent sub-total esophagectomy and esophagoplasty sec/After neoadjuvant radio and chemotherapy)

-> The Eso-SPONGE therapy has been successful halving the index of inflammation after the first two sessions and generation of a neowall after seven sessions.

- Over tube placed - guide insert preshaped polyurehtane sponge
  - -125 mmHg suction
  - sponge shcanged every 3 days
- Checked with CT scan
  - should be able to see through CT
  - 
- Eso-SPONGE® has a higher success rate than a stenting procedure (86.4% vs. 60.9%)
- lower treatment times (26.5 days vs. 36)

Conclusion:

The material need to be scanned through imaging system, and strong enough to undergo sealing test / gastrographin.

2026/02/11: ISO-10993-1

YEANNE HWANG - Apr 22, 2026, 2:01 PM CDT

Title: About ISO-10993-1

Date: 2026/02/11

Content by: Yeanne

Present: Yeanne

Goals: Research about standardization for medical devices

Search Terms: google: ISO 10993

Citation:

International Organization for Standardization, “ISO 10993-1:2018,” *ISO*, 2018. https://www.iso.org/standard/68936.html

Link:https://www.iso.org/standard/68936.html

Content:

About ISO-10993-1

- Framework for Biological Evaluation:
  - Provides a **risk-based approach** for evaluating the biological safety of medical devices as part of an overall biocompatibility assessment.
- Risk Management Integration:
  - Aligns with ISO 14971 by requiring risk analysis, justification for test selection or omission, and consideration of existing data to minimize unnecessary animal testing.
- Material and Device Considerations:
  - Emphasizes the importance of material characterization, intended use, contact duration, and contact type (e.g., skin, blood) when determining necessary tests.
- Test Selection Guidance:
  - Offers a decision-making matrix to select relevant biological tests (e.g., cytotoxicity, sensitization, genotoxicity) based on the nature and duration of body contact.
    - Classifications :
      - Body contact: skin, mucosal membranes ...
      - duration of contact : Prolonged ~24 hours to 30 days, or long-term contact beyond 30 days
      - Prolonged mucosal contact : requires tests include cytotoxicity, sensitization, irritation, systemic toxicity, and chemical characterization.
- Emphasis on Ethicals:
  - Encourages the use of existing data, in vitro methods, and chemical characterization to reduce or replace animal testing whenever possible.

Conclusion:ISO 10993-1 provides a risk-based approach to assess the biocompatibility of medical devices.

2026/04/02 Degradation testing example

YEANNE HWANG - Apr 29, 2026, 2:24 AM CDT

Title: Degradation testing

Date: 2026/4/2

Content by: Yeanne Hwang

Citation:

Shah Bukhary, S. K. H., Choudhary, F. K., Iqbal, D. N., Ali, Z., Sadiqa, A., Latif, S., Al-Ahmary, K. M., Basheer, S., Ali, I., & Ahmed, M. (2024). Development and characterization of a biodegradable film based on guar gum-gelatin@sodium alginate for a sustainable environment. RSC advances, 14(27), 19349–19361. https://doi.org/10.1039/d4ra03985h

Contents:

1. Material

    Base Matrices: Guar gum and Sodium alginate (Na-Alg) provide the structural backbone.

- Performance Boosters: Gelatin
    - Latex/Glycerol: These act as plasticizers to ensure the coating is flexible and doesn't crack upon drying.
    - Corn Starch: Excellent for increasing the overall biodegradation rate at a lower cost.

2. Synthesis Protocol (Solution-Casting)

1. Heating & Stirring: Dissolve polymers in water at 60–90°C to ensure a homogeneous mixture.
2. Blending: Gradually add plasticizers (glycerol/latex) to the polymer solution.
3. Curing: Pour the mixture into flat molds (like Petri dishes) and dry in an oven at 60°C for 16–20 hours.

3. Key Testing Parameters (Characterization)

- Thickness Control: Aim for a thickness below 0.25 mm (the Japanese Industrial Standard for food-grade films).
- UV-Vis Spectroscopy: Test the light transmittance between 250–800 nm. A good coating should reflect UV light to prevent oxidation of the coated material.
- Thermal Analysis (TGA/DSC): Determine the decomposition temperature. The study found stability up to 300°C, which is a strong benchmark for durability.
- Morphology (SEM): Check for a porous structure. Interconnected pores are critical because they facilitate fluid absorption and allow microorganisms to break down the material faster.

2026/04/06 Degradation testing in GI track

YEANNE HWANG - Apr 10, 2026, 1:27 PM CDT

Title: Material degradation testing

Date: 2026/03/28

Content by: Yeanne

Present: Yeanne

Goals: Research about testing methods/manual

Search Terms: NIH:degradatio test

Linkhttps://pmc.ncbi.nlm.nih.gov/articles/PMC8242228/

Content:

A. Simulated gastric degradation

Use simulated gastric fluid (SGF) and place the sponge or coated sponge in it at 37°C.

- Sample size: 1 specimen per tube, cut to the same size each time.
- SGF volume: 10–20 mL per specimen.
- Temperature: 37°C.
- Time points: 0.5 h, 1 h, 2 h, 4 h, and 8 h.
- Readouts: mass loss, visual shape change, swelling, and SEM before/after.

How to do it:

1. Weigh the dry sample: W0W_0W0.
2. Immerse in SGF for the selected time.
3. Remove, gently blot the surface, and weigh again: WtW_tWt.
4. Calculate mass remaining or mass loss.
5. Take photos and, if possible, SEM images.

A simple formula is:

- Mass loss (%) = (W0−Wt)/W0×100(W_0 - W_t) / W_0 \times 100(W0−Wt)/W0×100

B. Mechanical test after wet exposure

- 1 specimen per test
- Soak in SGF for 1–4 h
- Then run a compression test immediately.

Recommended readouts:

- Compression strength.
- Recovery after release.
- Visible cracking or delamination.

- Coating retention on the sponge surface.

How to do it:

1. Measure dry compression behavior first.
2. Soak the sample in SGF.
3. Remove and test compression again while still wet or after brief blotting.
4. Compare before vs after exposure.

If the coating flakes off or the sponge collapses too easily, that is a sign the formulation is not stable enough for GI use

C. Antibacterial test

- Bacterial strains: 1 Gram-positive and 1 Gram-negative strain.
- Inoculum: about 10610^6106 CFU/mL.
- Sample: one disc or piece per condition.
- Incubation: 24 h at 37°C.

Typical outputs:

- Zone of inhibition.
- Bacterial adhesion on the surface.
- Colony count after contact.

How to do it:

1. Prepare bacterial suspension at about 10610^6106 CFU/mL.
2. Place the sponge or coating sample in contact with the bacteria.
3. Incubate for 24 h.
4. Plate serial dilutions or measure inhibition zone.
5. Compare coated vs uncoated sponge.

D. Cytotoxicity test

- Sample extraction ratio: often 0.1 g/mL or a surface-area-based ratio.
- Extraction medium: cell culture medium.
- Extraction time: 24 h at 37°C.
- Cells: commonly fibroblasts or relevant mammalian cells.
- Exposure: 24 h.

Readouts:

- Cell viability.
- Cell morphology.
- Metabolic activity assay.

How to do it:

1. Soak the material in culture medium for 24 h.
2. Filter the extract if needed.

3. Treat cells with the extract.
4. Measure viability after 24 h.
5. Compare with negative and positive controls.

2026/03/28 Material testing

YEANNE HWANG - Apr 10, 2026, 1:18 PM CDT

Title: previous EVT sponge coating material testing

Date: 2026/03/28

Content by: Yeanne

Present: Yeanne

Goals: Research about standardization for medical devices

Search Terms: google: EVT Testing

Link:https://freight.cargo.site/m/N228087549095284245150801573824 6/EVT24-Final-Report.pdf#page=17.09

Content:

1. Testings

- Deployment Efficiency: Measure how fast the casing (Gelatin) dissolves to release the device.
- Functional Longevity: Ensure the biodegradable layer (Alginate/PLGA) prevents tissue ingrowth for at least 7 days.
- Degradation Mechanics: Distinguish between Hydrolysis (water-triggered) and pH-dependent erosion.

2. Gelatin Casing Performance (Current Benchmark)

- Dissolution Method: Comparison between pill capsules and dip molding methods.
- Trigger Mechanism: Use of an endoscopic water jet to accelerate dissolution.
- Observation Challenges: Difficult to visualize via endoscope; requires high-performance optics to confirm complete removal.
- Clinical Result: Serves as the primary vehicle for navigating the esophagus to the pyloric canal.

3. Alginate & PLGA Longevity Test (Simulation)

Environment Setup:

- Medium: Lemon juice (pH 2.0 – 3.0) to mimic gastric acid (pH 1.5 – 3.5).
- Temperature: Room temperature (though 37°C is recommended for future live-sims).
- Metric for Success: * Measurement of thickness every 12 hours for one week.
- Target: Must last long enough to delay tissue ingrowth beyond the standard 3-4 day limit.
-
- Degradation Logic:
- Critical Depth: 1.0 mm (depth where tissue grows into 1-2 layers of sponge pores).
- The "8-9 Day" Estimate: If the film lasts 5 days + 3-4 days of sponge safety = total 8-9 days before replacement is mandatory.

4. Comparative Biodegradability Factors
Gelatin:

- Pros: Rapid dissolution, excellent biocompatibility.
- Cons: Highly sensitive to moisture; may dissolve prematurely if not handled quickly.

Alginate:

- Pros: More stable in acidic environments; creates a protective "hydrogel" barrier.
- Cons: Requires ion-exchange (calcium) for stability; potential to clog vacuum tubes if it degrades into large mucoid fragments.

5. Safety & Vacuum Integration (Critical)

- Vacuum Integrity: Any material (Alginate or Gelatin) must not obstruct the 125 mmHg active vacuum.

- Suction Test: Must prove that degraded film particles can pass through the 2.5 mm PVC tube without causing a blockage.
- Biohazard Protocol: All test materials (including pig stomach models) must be disposed of in red biohazard bags after the dissolution test.

2026/02/09 design idea

YEANNE HWANG - Feb 13, 2026, 2:01 AM CST

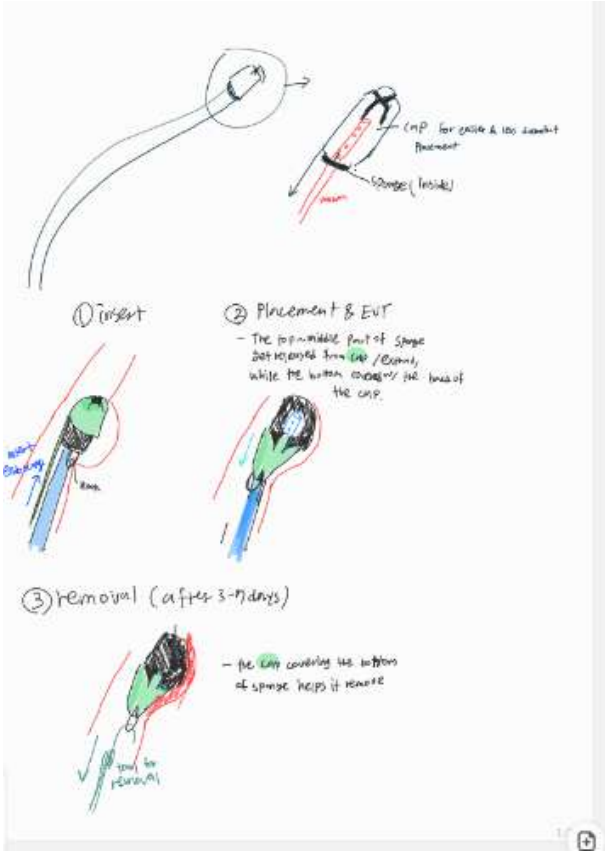
Title: design idea 1

Date: 26/02/09

Content by: Yeanne

Present: NA

Content:



Conclusions/action items:

Is the cap idea feasible? how would it be different based on size of cavity

2026/04/10 CAD mold design 1

YEANNE HWANG - Apr 29, 2026, 10:02 PM CDT

Title: CAD mold 1

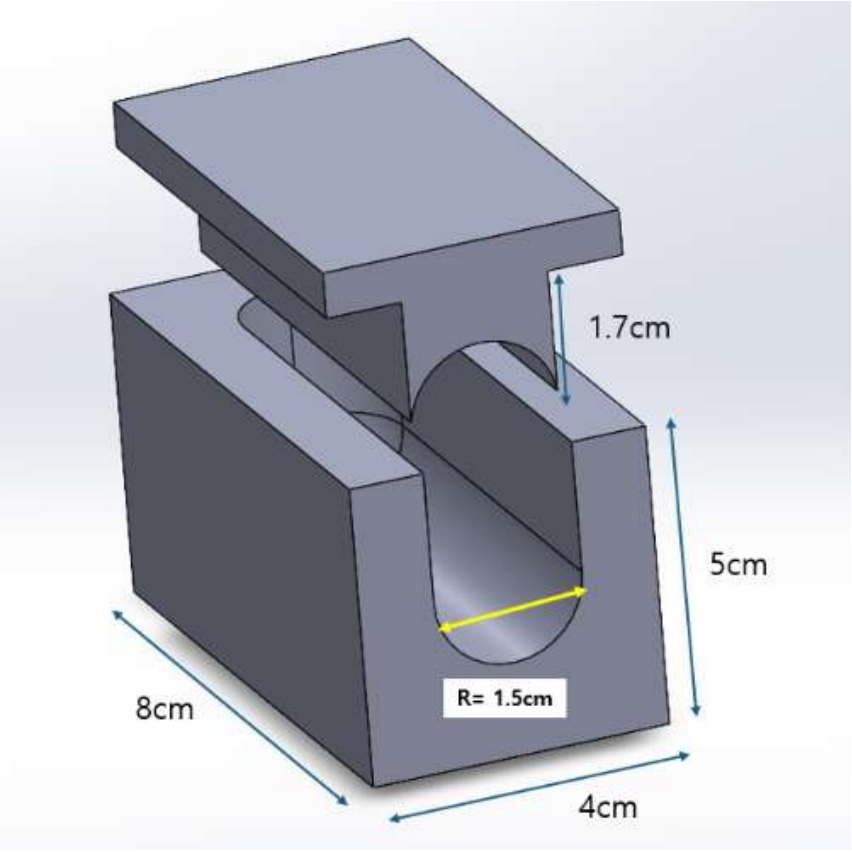
Date: 26/04/10

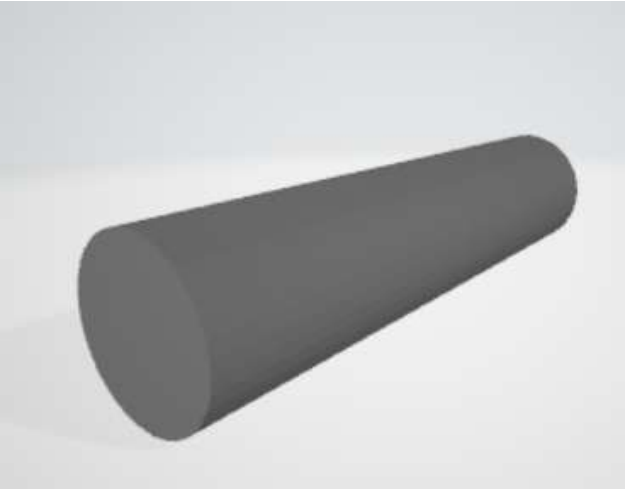
Content by: Yeanne

Present: NA

Content:

file attached





compression cylinder

Diameter=1.5, 2.5cm

Conclusions/action items:Test if it is expecting size of compression

YEANNE HWANG - Apr 29, 2026, 10:01 PM CDT

Download

Part3.3MF (31.6 kB)

YEANNE HWANG - Apr 29, 2026, 10:01 PM CDT

Download

Part2.3MF (5.33 kB)

YEANNE HWANG - Apr 29, 2026, 10:01 PM CDT

Download

Part1.3MF (44.4 kB)

2026/04/14 CAD mold design 2 & different sizes

YEANNE HWANG - Apr 29, 2026, 10:03 PM CDT

Title: mold design 2

Date: 26/04/14

Content by: Yeanne

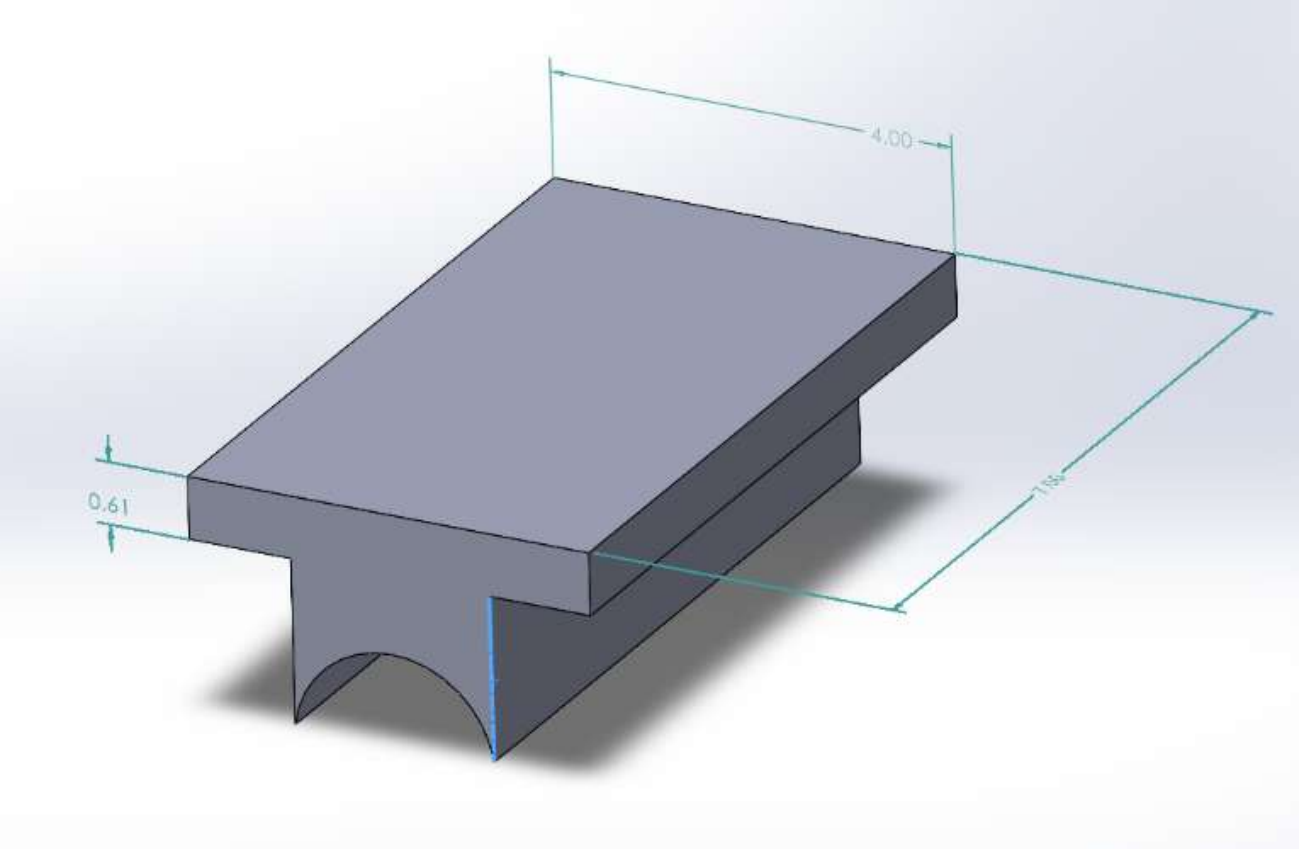
Present: NA

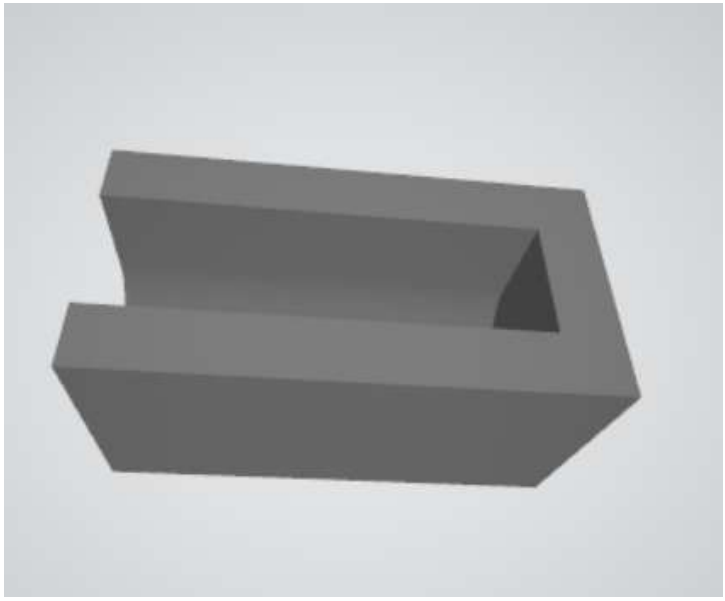
Content:

file attached

Diameter=2cm reprinted with PETG.

The design was optimized by removing redundant sections to reduce material consumption.





Conclusions/action items:Find if TPU or PETG is better for mold. Carve the end with spherical design

YEANNE HWANG - Apr 29, 2026, 10:02 PM CDT

Download

Part1_2cm.3MF (13.2 kB)

YEANNE HWANG - Apr 29, 2026, 10:02 PM CDT

Download

Part2_2cm.3MF (14 kB)

2026/04/15 CAD mold revised

YEANNE HWANG - Apr 29, 2026, 10:04 PM CDT

Title: mold design 3

Date: 26/04/15

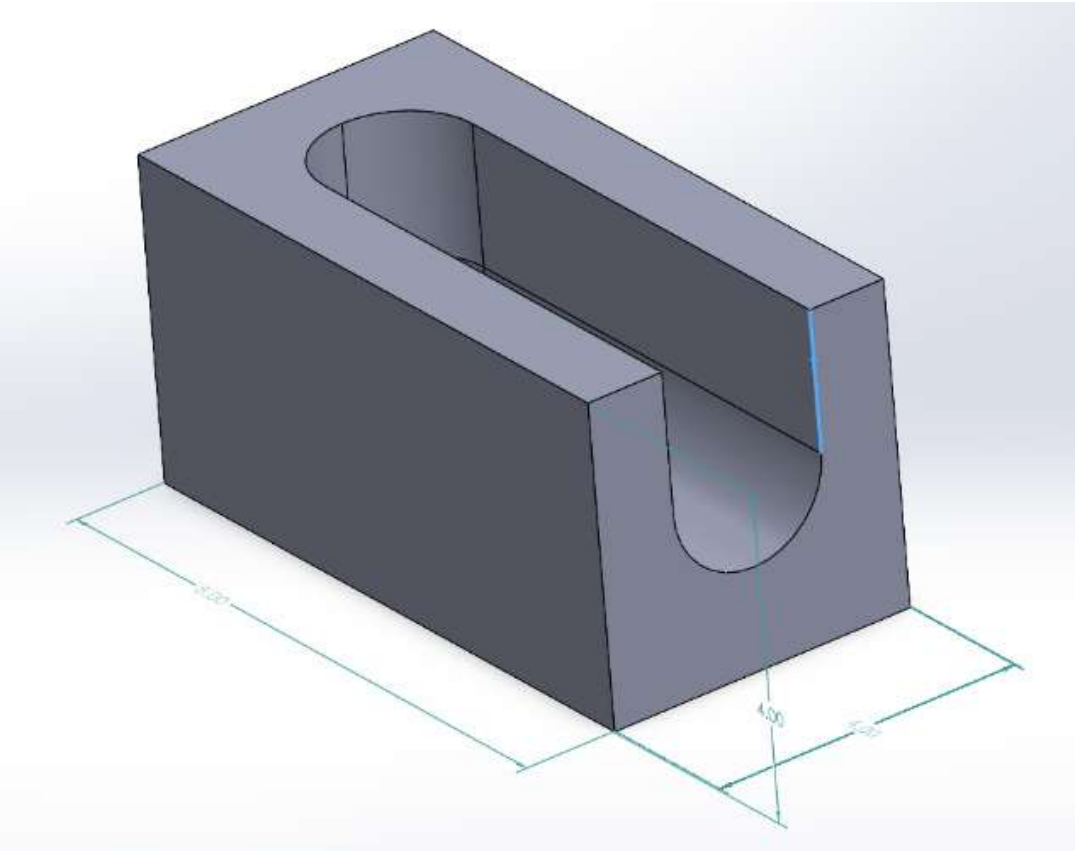
Content by: Yeanne

Present: NA

Content:

file attached.

Edge revised into spherical shape.



YEANNE HWANG - Apr 29, 2026, 10:04 PM CDT

Download

Part1_1.5cm.SLDPRT (158 kB)

Training Doc

YEANNE HWANG - Mar 18, 2026, 12:35 AM CDT

Title: Completed Trainings

Date: 2026/03/11

Content by: Yeanne Hwang

Content:

OVCR Training Information Lookup Tool **University of Wisconsin-Madison**

UNIVERSITY OF WISCONSIN-MADISON

This certifies that Yeanne Hwang has completed training for the following course(s):

Course	Assignment	Completion	Expiration
2025-2026 HIPAA Privacy & Security Training	2025-2026 HIPAA Privacy & Security Training	2/27/2026	
Biosafety 102: Bloodborne Pathogens for Laboratory and Research	Biosafety 102: Bloodborne Pathogens Safety in Research Quiz 2026	3/1/2026	3/1/2027
Biosafety 105: Biosafety Cabinet Use	Biosafety 105: Biosafety Cabinet Use Quiz	3/1/2026	No Expiration
Biosafety 106: Autoclave Use	Biosafety 106: Autoclave Use: Safety and Efficacy - Verification Quiz	2/26/2026	No Expiration
Biosafety 107: Centrifuge Safety	Biosafety 107: Centrifuge Safety Verification Quiz	6/24/2025	No Expiration
Biosafety Required Training	Biosafety Required Training Quiz 2024	3/9/2025	3/9/2030
Chemical Safety: Cryogen Safety Training	Part 1 Final Quiz	6/17/2025	6/17/2030
Chemical Safety: Cryogen Safety Training	Part 2 Final Quiz	6/17/2025	6/17/2030
Chemical Safety: Fume Hood Safety Training	Fume Hood Final Quiz	6/17/2025	6/17/2030
Chemical Safety: Sharps Training for Chemical Manipulations	Sharps Final Quiz	6/17/2025	
Chemical Safety: The OSHA Lab Standard	Final Quiz	3/8/2025	
Disposing of Hazardous Chemicals	Final Quiz	6/17/2025	6/17/2030
Dual Use Research of Concern (DURC) and Pathogens with Enhanced Pandemic Potential (PEPP)	DURC/PEPP Quiz	2/27/2026	2/27/2029

2026/01/28 Library research

YEANNE HWANG - Jan 28, 2026, 1:58 PM CST

Title: library research

Date: Jan 28 2026

Content by: Yeanne

Present: Anne Glorioso, Yeanne

Content:

- adding on zotero
    - can add snap shot of the paper in attachment

Defense Technical Information Center

- For technical research

- Technical reports publish the results of scientific or technical research, often using federal funds. The research is performed and reports are produced by companies, universities and government laboratories.

- "WORDS WORDS" -> stay together when search

Conclusions/action items:

2026/02/11 Interview prep

YEANNE HWANG - Feb 11, 2026, 1:49 PM CST

Title: interiew / presentation

Date: 02.11 2026

Content by: Yeanne

Present: Yeanne

Content:

- Bullets: top left bullet line up
- font: consistant all the slides
- organization: use logic flow. onot just chronological order.
- keep people interested
    - so what? why is it matter?
    - attitude: don't talk down
    - be excited
- no single hanging bullets
- image
    - Figure X. (what it is) show key function, citation.
- for graph
- FX. what is measured, as a function of indepednednt variables

Interview

- bring a small portfolio
- how to stand out: be personal
-

Conclusions/action items:

2026/02/25 DEI

YEANNE HWANG - Feb 26, 2026, 6:53 PM CST

Title:DEI

Date: 02.25 2026

Content by: Yeanne

Present: Yeanne

Content:

- Diversity & inclusion are core to good engineering design
- Diversity includes sleep, nutrition, mood, etc.
- A diverse team brings different knowledge and makes designs more effective and applicable to many users

DIversity Design

- Definition: design usable by all people, as far as possible, without needing special adaptations
- Moves away from designing for the “average user” to serving the widest audience

Principles of Universal Design

- Equitable Use – safe, private, appealing for people with varied abilities
- Flexibility in Use – offers choices, adaptable methods for different preferences
- Simple & Intuitive Use – easy to understand, no extra training or language barriers
- Perceptible Information – conveys needed info under any condition, supports visual/hearing limits
- Tolerance for Error – minimizes hazards; especially important when kids use the product
- Low Physical Effort – ergonomic, lightweight, reduces fatigue
- Size & Space for Approach & Use – works for all body sizes, postures, mobility levels

- Ethics connection: engineering ethics = maximizing comfort, quality, happiness for the most people → universal design is an ethical duty
- examples:
  - Crosswalk button with no feedback =need clear, perceptible signals
  - Rowing machine unreachable for a user with fused spine =size/space principle
  - Color meanings differ by country (e.g., red for “low” vs. “good”) =cultural flexibility
  - 3D-printed edges need grounding to avoid cuts =low-error tolerance

Brainstormong

- Teams listed diversity ideas: different viewpoints, skill sets, cultural/religious beliefs, price accessibility, testing with multiple demographics, multiple design versions, adjustable sizes, etc.
- applying universal design principles to projects:
    - Adjustable media/lateral pieces for multiple patients
    - Color-setting options in glucose-app for different countries
    - Preassembled surgical tool to reduce steps (simple & intuitive)
- **Conclusions/action items: DEI is necessary for engineering project**

YEANNE HWANG - Feb 26, 2026, 7:35 PM CST

- Adjustable media/lateral pieces for multiple patients

Modular components ensure that a single device can comfortably accommodate various body types, maximizing clinical utility.

- Color-setting options in glucose-app for different countries

I think this as a important step in tailoring digital health to cultural contexts, which prevents confusion.

- Enclosed circuitry & rounded 3D-printed parts for child safety (tolerance for error)

Its important to prioritize this for pediatric safety. Using rounded geometry and keeping the electronics inaccessible is a simple and effective.

- Adjustable lung phantom sizes & disease states (size & space)

Being able to toggle between different sizes and pathologies makes the phantom a much more robust tool for high-fidelity testing.

- Low-profile sensor attachment, safe for all skin types (equitable use)

Designing skin safe sensor helps the device dont interfere with the user's daily use. It will be a huge benefit for accessibility.

- Finger prosthesis with interchangeable segment lengths for various ages/conditions (equitable use)

Designing the product adjustable based on user is necessary, and it is efficient to use changeable segment as it can standardize manufacturing process while fulfill diverse user's needs.

- Tracker border colors for different skin tones (equitable use)

This is a great idea that i never thought of.For the purpose of the design, it is important to make it feel like natural extension of body.

2026/03/04 Library Research

YEANNE HWANG - Mar 04, 2026, 2:04 PM CST

Title: Library Research

Date: 03.04.2026

Content by: Yeanne

Present: Yeanne

Content:

- Market/Industry Sources
  - ► Data Axle Reference Solutions – directory information on businesses and demographic and lifestyle information on consumers
    - https://digital.library.wisc.edu/1711.web/referenceusa
  - ► IBISWorld Industry Reports – market research reports on over 700 U.S. industries
    - https://digital.library.wisc.edu/1711.web/ibisworld
  - ► ProQuest One Business – full-text business journals, newspapers, dissertations, and industry report
    - https://digital.library.wisc.edu/1711.web/proquest-onebusiness
- Patent
  - Search in **Lens.org**
    - eg.: we have an idea for a bouncing squirrel feeder => We know of a similar device, The Squngee®,with patent numbber on package : US 6,474,260
      - Search number on Lens.org
      - How to expand search
        - citations
        - search keywords
        - search tool - classification
        - Group by simple family
        - classification searching
- **Conclusions/action items: Search patent for my project**

YEANNE HWANG - Mar 04, 2026, 1:24 PM CST

- Adjustable media/lateral pieces for multiple patients

Modular components ensure that a single device can comfortably accommodate various body types, maximizing clinical utility.

- Color-setting options in glucose-app for different countries

I think this as a important step in tailoring digital health to cultural contexts, which prevents confusion.

- Enclosed circuitry & rounded 3D-printed parts for child safety (tolerance for error)

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2026/03/06 Tong Lecture

YEANNE HWANG - Mar 06, 2026, 6:36 PM CST

Title: Tong Distinguished Lecture

Date: 2026.03.06

Content by: Yeanne

Present: Yeanne, Dr. Williams

Contents: Dr. Williams presentated his great experiences with many companies that he owned. It was great to learn how diverse and how far he went and how to build expertise with acumulating experiences and networks.

2026/03/11 Protocol development

YEANNE HWANG - Mar 11, 2026, 1:48 PM CDT

Title: Protocol development

Date: 2026.03.11

Content by: Yeanne

Present: N/A

Contents:

Materials- detailed list (make table)

Methods - steop by step plan

-mix for how long

- cut will what tool and what size

**need to be repeatable by unfamiliar reader

3D printing

- material, method, dimensions ...

-
- Same rules apply - plus more
- Materials
  - Manufacturer and model of the printer
  - Filament material, diameter and model number
- Methods - printer settings
  - Layer thickness
  - Infill, speed, etc.
  - Support type and style
- gCode file

Manufacturing

Consider during process. cant manufacture everything you can 3D print

-
- Molding - blow, injection, thermoforming, extrusion, rotational
- Machining / subtractive manufacturing - mill, lathe, waterjet
- Joining - welding, soldering, screwing, riveting, adhesives

Protocol example

How long mixing takes, how it should it look like, methods to measure / mix, units

Fabrication Plan

- Team name:
- Team members:
- Project title:
- Timeline (Gantt chart):
- Materials and costs table:

Testing

#>3 -6

Controls: negative/positive/experimental control

2026/03/18 Elevator pitch

YEANNE HWANG - Mar 18, 2026, 2:01 PM CDT

Title: Elevator pitch

Date: 2026.03.18

Content by: Yeanne

Present: N/A

Contents:

Do:

maintain eye contact

keep concise, focused

tailor pitch to different audience

know ur audiences

focus on essentials

use clear / concise language

highlight key point

Dont

- Don't overwhelm with unnecessary detail

Abstract

- clear/concise/specific summary of ur work
- helps readers decide if they want to read full paper
- 150-300Ws

Technical Report

- eliminate extraneous text
- avoid conversational text
  - ** Basically/pretty much / ...
- spell out acronyms once
- remove redundancies

2026/03/25 Ethics

YEANNE HWANG - Mar 25, 2026, 2:07 PM CDT

Title: Ethics

Date: 2026.03.25

Content by: Yeanne

Present: N/A

Contents:

Personal vs Professional ethics

Personal : religion, how you grew ...

Professional : DEI

- Identify the dilemma – clearly state the ethical issue
- Understand the problem – research background, gather facts
- Generate possible actions – brainstorm multiple solutions
- Test/Analyze solutions – apply ethical tests to narrow choices

Ethical Tests

- Harm Test – which option minimizes negative consequences?
- Publicity Test – would the decision hold up under media scrutiny?
- Reversibility Test – could you accept it if a loved one were affected?
- Universality Test – could everyone act this way without harming society?
- Respect for Persons – does it protect rights and dignity?
- Utilitarian Test – greatest good for the greatest number, without marginalizing minorities
- Social Justice Tests – impact on vulnerable groups, distribution of harms, unavoidable negatives

Activity

The Guidant VPs: Most of the VP’s at Guidant are very much against reporting the data to the FDA. (a) How might they continue to justify their case? (b) What would be the moral foundations of their perspective?

- only care performance/result.

Patients and doctors: Think about the position of those directly impacted: primarily patients who might be candidates for this surgery, and the doctors who use the device: (a) what arguments would those people want to ensure are considered by both the VPs and the design engineers about whether to report or not report the complications data? (b) What might be the ethical foundations of their perspective?

- That they are not on charge

The design engineers: (a) What else can they say or do? (b) What arguments can they try to make, and to whom?

- talk to VPs / go to FDA

The design engineers: What options do they have? Generate a list of possible options (a minimum of 3 from the perspective of the design engineers), describe how each stakeholder is affected, then analyze them using the BME Code of Ethics (https://www.bmes.org/2025/cmbeconference/codeofconduct) and a couple of tests from the ethical decision-making system. Explain in detail the best option you would consider trying to act

- go talk to someone? make more option to choose

- What components of your design have ethical dimensions (be specific and list at least 2)?
  - Can be invasive and harm patients / Use cheap & fabricatable material than using best option for patients

- How will your team address the ethical dimensions? (What is your action plan?)
  - Make diverse prototype so that the patients can have options

2026/04/08 Engineering Judgement

YEANNE HWANG - Apr 08, 2026, 2:02 PM CDT

Title: Engineering Judgement

Date: 2026.04.08

Content by: Yeanne

Present: N/A

Contents:

- real world engineering problem

- embrace uncertainty

-

A Model for Engineering Judgement

(Adapted from D. Chadha, Imperial College London)

Attitudes (internal) **What you feel and believe about a specific issue.**	**Behaviours (external)** **How you demonstrate and act upon your knowledge and attitudes while addressing a specific issue.**	**Cognitive (internal & external)** **What you know about, and are able to do, to address a specific issue.**
When you consider applying Engineering Judgement to a complex issue, to what extent is it helpful for you to:	When you consider applying Engineering Judgement to a complex issue, to what extent is it helpful for you to:	When you consider applying Engineering Judgement to a complex issue, to what extent is it helpful for you to:
A1. Realize that pure memorization can lead to constraints	B1. Take responsibility for your own learning	C1. Clearly identify a problem
A2. Appreciate that education is a foundation for lifelong learning	B2. Ask questions for clarification and deeper understanding	C2. Apply logic to engineering work
A3. Possess a deep passion for engineering as a discipline	B3. Treat failure as a lesson	C3. Use a sequential thought processes in engineering work
A4. Know that an individual's judgement is a limited perspective and can limit broad application	B4. Document rules, lessons learned, and procedures throughout the design process	C4. Demonstrate competency in a defined content area
A5. Comfortably respond to making mistakes (yours and others)	B5. Value creative contributions from self and others toward the desired objectives	C5. Apply fundamental theoretical knowledge to engineering work
A6. Comfortably celebrate individual and team success	B6. Reflect on how assumptions and biases influenced the outcome	C6. Articulate the context and consequences that go beyond merely a technical solution
A7. Feel a sense of self-confidence in making decisions	B7. Engage in the process of continuous improvement	C7. Use imagination and intuition in engineering work
A8. Value collaboration with others over competition with others	B8. Use past experiences to inform future work	C8. Exercise common sense to draw conclusions and make reasonable recommendations

2026/04/15 Poster Presentation

YEANNE HWANG - Apr 29, 2026, 1:44 AM CDT

Title: Poster Presentation

Date: 2026.04.15

Content by: Yeanne

Present: N/A

Contents:

Designs

Good

Flow & Alignment: Ensure a logical progression of ideas and professional alignment.

Visual Balance: Use high-quality pictures and label every figure. Avoid overwhelming the viewer with too much blank space.

Conciseness: Be detailed but brief. Use bullet points instead of long paragraphs.

Accessibility: Body text must be readable from 3ft away (Font size: 24-28pt).

Bad

Clutter: Small text, "word walls," and raw data dumps.

Lack of Context: Unexplained pictures/data or CAD drawings without clear purpose.

Inconsistency: Mismatched fonts, sizes, or formatting styles.

Redundancy: Repeating the same info in text and figures

Structural Requirements

Storyline: Connect your technical data to the "bigger picture" (e.g., how it fits into a clinical setting).

Caption Formula: Figure Label + Title (Optional) + Description + Citation.

Contact Info: Must include professional and accurate contact details

Evidence: Show your Best Results prominently.

Logistics & Resources

Printing: Use the UW-Madison library system. Double-check the required specifications before submission.

References: Review previous lecture notes and the design resources provided on the course website.

Rubric: Read the evaluation requirements carefully to ensure all grading criteria are met

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

MARIAH SMEEDING - Jan 28, 2026, 1:17 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: