BME Design: Progress reports

Title: Milrinone alternative delivery system

Date: 10/2/2026

Client: Dr. Lenard Markman
Advisor: Prof. William Murphy
Team: Beyond the IV

Samuel Glanville - *Team Leader*

Yisi Yang - *Communicator*

Steve Lee - *BSAC*

Katie Wright - *Co-BWIG*

Noelle Johnston - *Co-BWIG*

Leo Thayer - *BPAG*

Problem statement

Congestive heart failure (CHF) patients use Milrinone therapy, but current delivery relies on IV administration, limiting outpatient use and long-term management. There is a need to develop and validate alternative, non-invasive delivery formulations of Milrinone, such as nebulized/inhaled, oral (tablet or liquid), or nasal spray for rapid daytime symptom control, paired with a longer-acting oral formulation for sustained nighttime dosing that achieve therapeutic equivalence to existing delivery methods while minimizing side effects and improving patient adherence and quality of life.

Brief status update

Upon further research, our team has decided to reconsider our final design. We have concluded that designing extended release capsules may be beyond our resources and information. However, we are now reconsidering the milrinone pouch design. This week we are planning on conducting research on caffeine/nicotine pouches to gain more information on the solubility and absorption of those molecules within a patient's mouth. Furthermore, we met with a cardiologist this week to gain more information on milrinone and get opinions on our design. He informed us that milrinone needs to be administered in gradual dosages, in order to not cause an overdose in patients. We are meeting in-person with our client on Monday to receive our budget and update him on our project.

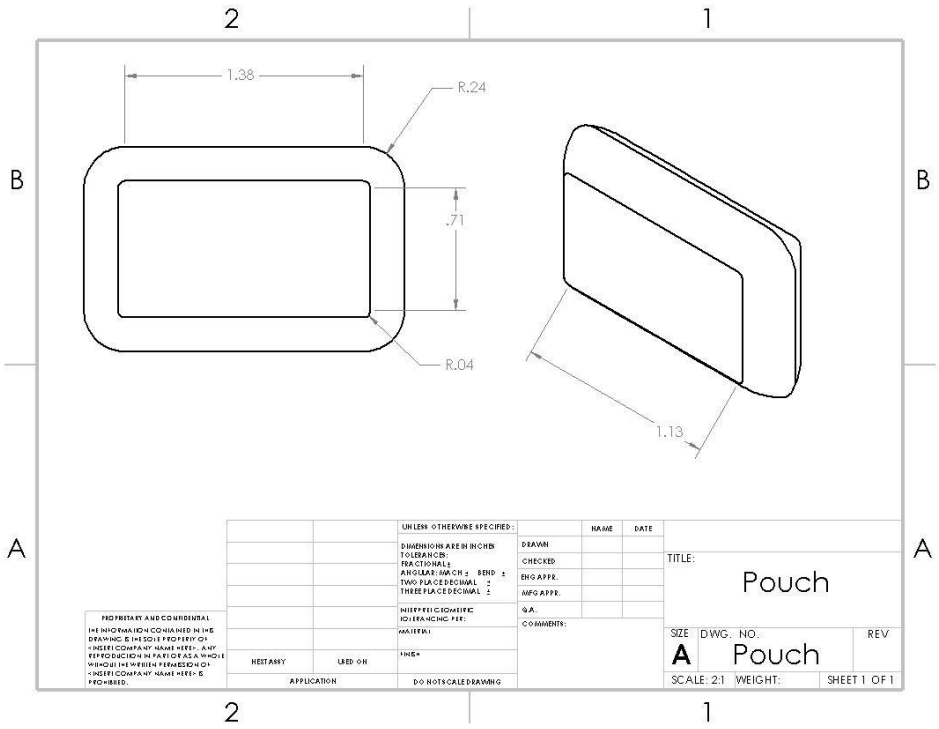
Difficulties/advice requests

Our project focuses on patients with stage D heart failure who currently receive milrinone through a portable intravenous (IV) infusion pump. We aim to investigate a more convenient delivery method that reduces the burden of IV

treatment while maintaining therapeutic support. The alternative should also address the needs of patients who have difficulty swallowing or cannot swallow oral tablets.

As a team and with use of the design matrix, the extended release capsule was selected to be the final design choice due to its ease of fabrication, ease of use, and lower dosage per day. A key uncertainty at this moment is figuring out a molecule that we can use for testing that is similar to milrinone, in terms of solubility and acidity. Furthermore, we are also hoping to meet with our client and determine how we can access our budget and any advice that he has on our design.

Current design



The current model of the pouch is designed to be the standard size of any market sublingual diffusion pouch. The material is a cellulose fiber. The design is intended to remain sleek and subtle so as to not cause discomfort or irritation within the gums.

Materials and expenses

Item	Description	Manufac-turer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Material Costs										
Sigma-Aldrich Lactic Acid, 100ml - SIAL	Chemical component of our design.	Sigma Aldrich	100ML	NETA SCIENTIFIC INC	SIALL6661-100ML	10/28/26	1	66.81 USD	$66.81	Here
THEOBROMINE 5G - A374174-5G	Chemical component of our design.	Ambeed	A374174-5G	VWR INTERNATIONAL LLC	77616-646	10/28/26	1	23.00 USD	$23.00	Here

Testing Costs										
									$0.00	
									$0.00	
								TOTAL:	**$89.81**	

- Starting budget of $100 from our client
    - We have applied for additional funds through the BME department for our chemical purchasing for a total of $89.81
- An additional budget of $50 can be accessed for Design Innovation Lab specific purchases such as 3d printing.

Goals

Major team goals for the next week

1. Order materials with an updated order form
2. Research formulation ratios that will provide desired output
3. Research or contact the clinician to determine the concentration gradient that will retain patient saftey
4. Research literature on the testing of a sublingual pouch
5. Research Natural adhesive for a pouch anchor to a tooth for choking hazard prevention

Next week's individual goals

- Samuel Glanville
    - Research correlation between drug concentration in saliva and concentration in blood stream
    - Begin pouch fabrication
- Yisi Yang
    - Continue research about correlation of drug concentration in saliva and concentration going into the blood stream
    - Research about possible pouch adhesives
    - Prepare for show and tell questions
- Steve Lee
    - Fabricate testing chemical if material arrive

- Draft testing protocol
- Try and see where can the concentration be tested

- Katie Wright
  - Begin fabricating our first prototype when the rest of our materials arrive
  - Begin the testing process
  - Continue researching literature to find a mathematical equation to test the concentration of milrinone
- Noelle Johnston
  - Begin fabrication of the pouch and design our first prototype.
  - Write the testing protocols.
  - Research absorption equations for medication pouches.
- Leo Thayer
  - Synthesize our lactate salt
  - Complete production of first design prototype

Timeline

Task	Sep				Oct					Nov				Dec	
	4	11	18	25	2	9	16	23	30	7	14	21	28	5	9
Project R&D															
Background Research	x	x	x	x											
Preliminary Design Work			x	x	x										
Design Specific Research					x	x	x								
Model and Simulate Design									x						
Purchase Materials							x	x	x						
Fabrication									x						
Testing															
Fabrication Adjustments															
Final Prototype															
Final Poster															
Task	Sep				Oct					Nov				Dec	

Filled boxes = projected timeline
X = task was worked on or completed

Detailed accomplishments

Previous week's goals and accomplishments

- Samuel Glanville
    - Meet with the client about budget
    - Researched pathway from gum to bloodstream
    - Researched testing methods
- Yisi Yang
    - Research testing environment
    - Meet with the client about the budget and finalize our design
    - Meet with cardiologist to check if our design is feasible
    - Research about teeth or adhesive anchor for the pouch design
- Steve Lee
    - Meet with Dr. Raval for consultation
    - Research on delivery method for pouch design
    - Complete required trainings and gain access to training lab
- Katie Wright
    - Continued researching existing testing of nicotine pouch absorption pathway
    - Prepared for our elevator pitch
    - Completed intro to machining training
- Noelle Johnston
    - Researched testing methods.
    - Completed Introduction to Machining.
- Leo Thayer
    - Acquired multiple materials
    - Created a synthesis plan for our co-crystal salt

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Samuel Glanville	9/9/2026	CAD	1	2	6
Samuel Glanville	10/2/2026	Research	2	2	14
Samuel Glanville	10/2/2026	Preliminary Deliverables	5	6	7
Samuel Glanville	10/2/2026	Meetings	1.5	1.5	8.5
Yisi Yang	9/8/2026	Client Meeting	0.8	0.8	0.8
Yisi Yang	9/13/2026	Client Meeting	0.8	0.8	1.6
Yisi Yang	9/16/2026	Background Research	2	2.8	3.6
Yisi Yang	9/17/2026	Client requirement part of PDS	1	3.8	4.6
Yisi Yang	9/21/2026	Background Research	2	2	6.6
Yisi Yang	9/21/2026	Teams Meeting	1.5	3.5	8.1
Yisi Yang	9/28/2026	Research on previous studies	1.5	1.5	9.6
Yisi Yang	9/30/2026	Presentation Team meeting	1	2.5	10.6
Yisi Yang	10/02/2026	Research about mimic small molecule	1.5	1.5	12.1
Yisi Yang	10/12/2026	Team meeting about design matrix for the mimic molecule	1	1	13.1
Yisi Yang	10/16/2026	Meeting about switching design	0.5	1.5	13.6
Steve Lee	9/10/2026	Background Research	1	1	
Katie Wright	10/11/2026	Milrinone mimic compound research	1	2	10.1
Katie Wright	10/12/2026	Team meeting matrix	1	2	10.1
Katie Wright	10/15/2026	Research into design flaws of capsule	1	1	1
Katie Wright	10/19/2026	Inperson meeting with client	1.5	4	14.1
Katie Wright	10/21/2026	Research on adhesives and pouch absorption pathway	2.5	4	14.1
Katie Wright	10/29/2026	Prepared for elevator pitch	1	7	21.1
Katie Wright	10/28/2026	Completed intro to machining	4	7	21.1
Katie Wright	1026/2026	Researched existing nicotine pouch testing	2	7	21.1

Noelle Johnston	9/15/2026	Capsule Type Research	1.75	1.75	2.75
Noelle Johnston	9/16/2026	Various Sections of PDS	1	2.75	3.75
Noelle Johnston	9/20/2026	Sublingual Pouch Research	2	2	5.75
Noelle Johnston	9/21/2026	Design Matrix Team Meeting	1.5	3.5	7.25
Noelle Johnston	9/30/2026	Presentation Team Meeting	1	1	8.25
Noelle Johnston	9/29/2026	Slideshow Work	.5	.5	8.75
Noelle Johnston	10/8/2026	Progress Report	1.5	1.5	10.25
Noelle Johnston	10/8/2026	Milrinone Research	1	2.5	11.25
Noelle Johnston	10/19/2026	In Person meeting with client	1.5	1.5	12.75
Noelle Johnston	10/22/2026	Pouch Testing Research	1	3	15.75
Noelle Johnston	10/17/2026	Adhesive Research	2	2	14.75
Noelle Johnston	10/22/2026	Intro to Machining	5	8	19.75
Leo Thayer	9/8/2026	Background Research	1.5	1.5	1.5
Steve Lee	09/15/26	Client Meeting	1	1	2
Steve Lee	09/16/26	Contact potential collaborator	1	2	3
Steve Lee	09/17/26	Contact potential collaborator	0.5	2.5	3.5
Steve Lee	09/18/26	Research testing environment	1	3.5	4.5
Leo Thayer	9/16/26	Research oral milrinone and PDS	2	2	3.5
Leo Thayer	9/17/26	Pouch similar designs research	1	3	4.5
Steve Lee	09/21/26	Design Feasibility Research	1.5	1.5	6
Steve Lee	09/25/26	Potential Collaborator Meeting	2	3.5	8
Leo Thayer	9/25/26	BPAG and Team Meeting	1.5	1.5	6
Leo Thayer	9/22/26	Pouch side effect research	1.5	3	7.5
Steve lee	09/29/26	Contact potential collaborator	0.5	0.5	8.5
Steve Lee	09/30/26	Presentation slide and meetings	1.5	2	10
Steve Lee	10/01/26	Presentation slide	0.5	2.5	10.5
Leo Thayer	10/1/26	Presentation work and meetings	1.5	1.5	9
Leo Thayer	10/8/26	Preliminary Report Work	2	2	11
Steve Lee	10/12/26	Testing Research	1	1	11.5
Steve Lee	10/16/26	Dr. Rahko Meeting	0.5	1.5	12

BME Design: 200, 300, 301, 400 and 402

Steve Lee	10/19/26	Dr. Raval Meeting	0.5	0.5	12.5
Leo Thayer	10/13/26	Purchasing and Formulation Research	6	6	17
Leo Thayer	10/19/26	Form approval and Research	2	2	19
Leo Thayer	10/28/26	Synthesis Procedure Research	1	1	20