April 26 2025:

- Developed “rough outline” idea for what ClotGuard could be

1. provide a 1-liner [concept of what your team is working on

My team is working on solving the problem of the immensely long wait times of traumatic care, using freeze-dried platelets, delivered by nanobots, to prevent traumatic hemorrhage - applying immediate response time.

2. provide some detail on what problem you’re trying to solve / what opportunity you’re trying to create?

Hemorrhage, or uncontrolled bleeding, is a major cause of preventable deaths, especially when the body is affected by traumatic injuries. It’s estimated that hemorrhage accounts for 1.5 million global deaths every year, while excessive blood loss in injuries accounts for roughly 2 million deaths each year, for civilian-related accidents. On the battlefield, roughly 81.5% of fatalities were due to hemorrhage, and all fatalities occurred before the casualties reached a medical facility. Around 80% of ‘Died of Wounds’ on the battlefield (DOW) deaths were caused by hemorrhages from major trauma. Current methods to treat hemorrhages, both in civilian accidents and on the battlefield, are not suitable for traumatic injuries of that scale. We are trying to create the opportunity of fast, immediate traumatic care, rather than waiting a potential hour.

3. what is the “monkey” --> from this weekend’s session

For our group, the monkey is digging deeper into the problem and solution - why is it 10x? Is this possible in 10 years? How does this impact people? What are the benefits? Etc.

4. In your opinion, why is this a 10x solution to solving the problem?

Many of the deaths that occur (ex. ‘Died of Wounds’ on the battlefield (DOW) deaths), are very much preventable with the right technology. By using nanobots with micro-needle technology, we will revolutionize the sector of military centered care - with more precision, faster action, and higher survival rates.

April 27-May 1st 2025:

- Throughout this period, we did a lot of research for the rough idea of ClotGuard
- We created the theoretical idea for the patch/nanocarriers (materials, functions, etc.)
    - Problem and status quo
        - Current ways to treat hemorrhage on battlefield
        - Problem statistics
    - Science, tech, mechanics
        - Platelet science (why freeze-dried?)
        - Nanocarriers: what they are tracking and what they are made out of (PLGA, PCL, gold nanoparticles)
        - Patch components: what they are tracking and what levels (thrombin, heart rate, blood pressure, oxygen saturation)
        - Dosage amount released
    - Validating the idea with early interest

        - “Hi! It’s great to hear you’re working on such an impactful healthcare product. I think it’s a very novel idea!” **- Grace Fu (Pharmaceutical research at U of T’s Leslie Dan Faculty)**
        - “Hi, I think your idea is fascinating and certainly would be very useful to the medical field.” **- Issac Tang (Medical Researcher w/UCalgary)**
        - “The device in question is truly revolutionary. For people who are more likely to suffer serious injuries or clotting issues, a patch that can detect bleeding and distribute freeze-dried platelets exactly where they are needed could save lives. It's like having a personal, smart medic on your skin, ready to go in the event of an emergency. The potential of this technology to revolutionize emergency treatment and improve general safety truly fascinates me.” **- Mehak Nijjar (Board Member – Airdrie Affairs & Legal Insurance Liaison)**
        - “A beautiful integration of existing biosensor, microneedle and nano bot technologies, this is a simple and feasible yet effective idea that could tackle the problem of wound healing, which is so relevant for everyday life.” **- Diba Dindoust, Bioengineering, Stanford**
    - Challenges and risks, and the testing/validation plan (early ideas)
    - Economics
        - Financials
        - FDA approval
        - Funding opportunities
    - 5 year reach
        - “A lot of the technology that goes into our ClotGuard product is either currently functional in today’s world or is being actively utilized and tested with reliable and assuring results, making a lot of the technology feasible to use both today and in the next 1-2 years for refinement and testing the technology for this specifi application. But, the good news is that this isn’t science fiction, it's strategically engineered scientific concepts that could be implemented in the real world and actually save lives. Some of the later advancements of our product (spanning away from just traumatic hemorrhage and blood loss) are some of the technologies that would be feasible within a five year span. Those new applications and modifications would be advances or add-ons to the current technology that aren’t specifically necessary for the application ClotGuard was designed for. But, ClotGuard is a platform technology, so utilizing its existing backbone for other products or treatments is 100% feasible and is what makes the product so marketable and versatile.”
    - Made sure to answer these questions
        - Navigation: How do the nanobots know where to go inside a body that’s actively bleeding and traumatized?
        - Targeting: How do you distinguish between small, non-lethal bleeds and life-threatening hemorrhages?
        - Activation: How do you deploy the freeze-dried platelets exactly when and where needed?
        - Biocompatibility and Safety: How do you make sure they don’t trigger dangerous immune reactions or cause unintended clotting elsewhere?

        - How to engineer nanobots that can accurately find bleeding sites inside the body and deploy freeze-dried platelets effectively — fast, safely, and reliably — in a chaotic, traumatic injury environment.

May 2nd-May 8th 2025:

- This week we were practicing the presentation we had at the end of the week to showcase ClotGuard and what we developed
- In our presentation we made sure to cover these components
    - Problem (on the battlefield and civilian situations)
    - Current treatments (QuikClot and Celox gauze-based treatments)
    - Patch function and microneedles for storage/distribution
    - Nanocarrier materials and sensors
    - Deactivation
    - Case studies about our technology (platelets, nanocarriers, sensors)
    - Challenges with development (FDA, nanocarrier technology)
    - Financials of patch

May 9th 2025:

- Presented ClotGuard at our showcase in front of judges
- Got a lot of traction and support for the idea
- Was told it's a "true moonshot idea" (one of the judges)
- Won our city's competition for the program we were presenting for (The Knowledge Society or TKS)

June 7th 2025:

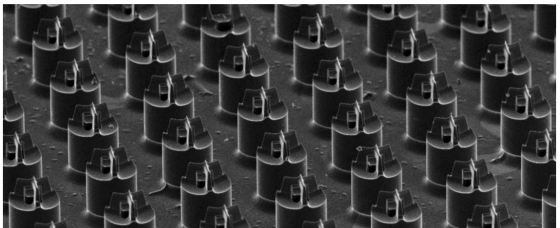
- Presented ClotGuard at the TKS end-of-year showcase

August 7th 2025:

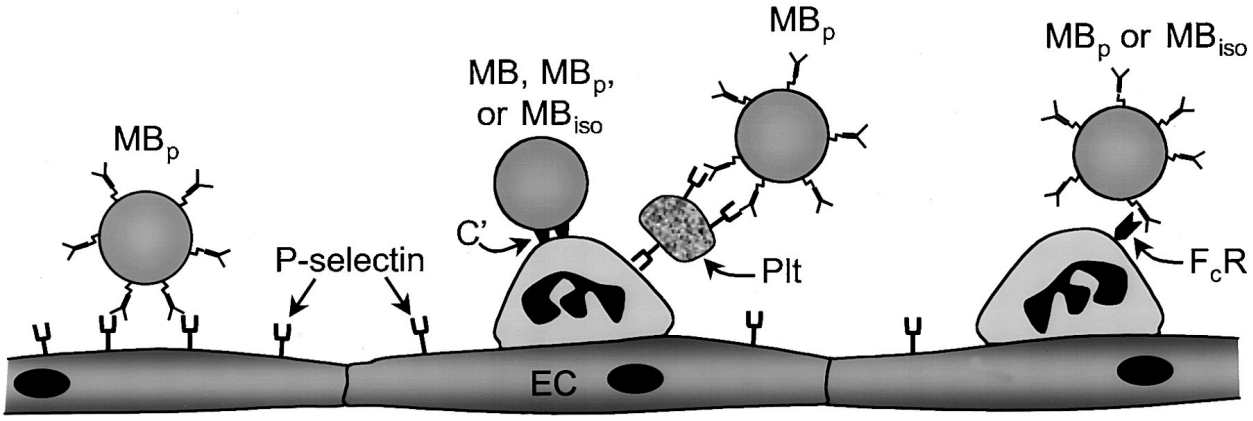
- Sophia Dhami scheduled a meeting with Dr. Michael Serpe at the University of Alberta
    - Learn more about microneedle technology
    - PLGA encapsulation technology for freeze-dried platelets

August 9th 2025:

- Developed the specificity components of the nanocarriers for ClotGuard:
- We can use molecular binders that only recognize exposed fibrin, activated platelet markers, or denatured collagen found at active wounds, not normal endothelium.
- This gives us that peace of mind that instead of JUST detecting thrombin, it can detect more specific biomarkers.
- Two requirements need to be met for the platelets to be attached.
- Binding condition → They physically attach to a wound-specific marker, like: Fibrin (forms in clots), activated platelet proteins (e.g., P-selectin, which is a cell adhesion molecule that is on the surface of activated platelets), and exposed collagen (only appears when blood vessel walls are damaged).
- Local trigger condition → The environment around them has a chemical cue that only happens during active bleeding, such as: High thrombin concentration (a clotting enzyme) Low pH (from tissue damage) Elevated protease activity (enzymes from damaged tissue)
  Only if both conditions are present would the payload (platelets, clotting agents, etc.) be released.



As you can see, this is the kind of anatomy that our microneedles at the bottom of the patch would have. We need it specifically to be controlled, integrated, and synced with the biomarker detection (which will be installed and integrated within the flap).



This is what p-selectins look like (diagram-based), but with this image you can really see how they're at the surface!

"ClotGuard uses a two-step safety system to ensure platelets are only released at the right place and time.

Step one — Binding condition: The nanobots attach only to wound-specific markers such as fibrin, P-selectin on activated platelets, or exposed collagen from damaged vessels. This ensures they localize only to active injuries.

Step two — Degradation condition: Once bound, special linker molecules holding the platelets degrade only when they detect local wound chemistry — such as high thrombin levels, low pH, or elevated protease activity.

When both conditions are met, the linkers break down and platelets are released directly where they're needed, preventing premature clotting anywhere else." - formed by Sophia Dhami and ChatGPT

August 10th 2025:

- We went to the university to meet with Dr. Michael Serpe and share more about ClotGuard
- We got to tour his labs and see all the work his students are developing as well as the technology the lab is known for
- Secured his support and offered to help with future testing and development of microneedles and PLGA nanoparticles

Questions/Topics to talk about:

- Immune detection, how to prevent issues with the nanobots
- Patch material for 2-3 days wear

- How to keep it safe from infection and germs, focus on antimicrobial properties for health and safety
- Different materials to use or recommendations based on what we've shown about ClotGuard
- Discuss interest to build ClotGuard further, what would that look like for labs and support
- "I read about these light-degradable hydrogels that can safely break down when exposed to light, making wound dressings easier to remove without pain. Since hydrogels can also be made into microneedles for controlled drug delivery, do you think it's feasible to combine these ideas—like making light-degradable hydrogel microneedles for ClotGuard? What are the main challenges or benefits in developing something like that?"
- Can microneedle-like patches be built from said material

ClotGuard x Serpe Lab – Meeting Questions

Patch & Nanobot Materials

1. From your experience with responsive polymers, which ones would work best for a skin patch that stays on for long periods without irritation?

2. Are there coating methods you've used that could help nanobots avoid immune detection while still functioning in blood?

3. For bloodstream use, what's the best balance between polymer flexibility and mechanical strength?

4. Could smart coatings be adapted to give our patch or nanobots antimicrobial properties without losing biocompatibility?

Triggering & Release

5. In your on-demand drug delivery work, how do you make sure the system only activates when the exact trigger is present?

6. What approaches do you use to get a material to respond quickly—seconds, not minutes—once it detects the trigger?

7. Could your polymer systems be designed to respond to specific bleeding biomarkers like thrombin or fibrin?

Prototyping & Testing

8. If you were starting from scratch on ClotGuard, what would you prototype and test first?

9. Do you usually run small-scale material tests first, or go straight to building integrated systems?

10. When you move from a lab prototype to something that works on a person, what are the biggest material changes you have to make? (ask if they HAVE tested on humans #befire)

Scaling & Strategy

11. Which responsive polymers scale well for manufacturing without losing their performance?

12. Would you recommend customizing our own polymer blend, or starting with something already approved for medical use to speed things up?

13. If you were prioritizing our build, would you focus first on the sensor accuracy, the release mechanism, or the material optimization?

August 12th 2025:

- Presented at the IEEE conference in Calgary about ClotGuard
- Updated our presentation to remove financials and instead add the meeting we had at the university and update on that future collaboration
- Connected with a few people from there who wanted to support our work and hear updates

August 17th 2025:

- After the tour at the lab, worked on developing a PLGA nanoparticle prototype and how that could function (with help from ChatGPT for formatting)

With **PLGA particles** as the chassis, your “sensors” are **chemical/biological moieties** that you **conjugate to (or embed in) the PLGA** so they (a) report local biochemistry and/or (b) **gate the release** of your platelet payload. PLGA itself is not a sensor—it’s the carrier. Below is a practical, build-ready menu for each biomarker, including **real molecules**, **how to attach them**, and **how they trigger release**.

How you attach things to PLGA (quick primer)

- **Expose handles on PLGA:** use **PLGA-PEG-COOH** or **PLGA-COOH** (carboxyl) or **PLGA-PEG-NH_2** (amine).
- **Common coupling chemistries:**
    1. **EDC/NHS** (carboxyl ↔ amine)
    2. **Maleimide–thiol** (if your ligand has a cysteine)
    3. **Click chemistry** (azide–alkyne) after installing azide/alkyne on PEG or ligand
- **Two placement options:**
    1. **Surface conjugation** (best for “gates” and targeting)
    2. **Core embedding** during nanoprecipitation (best for readout dyes)

Recommended MVP gating strategy (what’s realistic soon)

- **Primary trigger (now): Thrombin-cleavable peptide “cap”** on the particle surface (opens in high thrombin at bleed site).
- **Co-trigger (now): pH-labile linker** (hydrazone/ketal/ortho-ester) that accelerates release in acidic wound milieu (pH ≤ 6.8).
- **Reporters (now):** Oxygen and calcium **as readouts** (fluorescent dyes) to log local physiology; move to Ca^{2+} gating later if needed.

This gives you robust, clinically plausible release today, with richer sensing for analytics and future autonomy.

Concrete sensor/trigger options (with attachment & mechanisms)

Target	Example "Sensor"/Gate (proven reagents)	Where it goes	How to attach to PLGA	What it does / Trigger logic
Thrombin (release gate – primary)	**Thrombin-cleavable peptide linker** (e.g., **GGLVPR↓GSG**, **FGPR↓SL**; ↓ = cleave) tethered between particle surface and a **PEG "cap"**	**Surface**	Add **PLGA-PEG-maleimide**, conjugate peptide with **C-terminal cysteine** via **maleimide–thiol**, then attach a short PEG brush or shell through the peptide	At high thrombin (bleeding site), peptide is **cleaved**, PEG "cap" detaches, **pores open**, platelet cargo releases
pH ≤ 6.8 (co-trigger gate)	**Hydrazone / acetal / ketal / ortho-ester linkers** between PLGA surface and PEG cap (commercial hydrazide-PEG, acetal-PEG available)	**Surface**	**EDC/NHS** to install aldehyde/hydrazide pairs, or use pre-functional **pH-labile PEG** linkers	In acidic milieu, linkers **hydrolyze**, uncapping pores or loosening shell → **faster release**
Oxygen (reporter now; trigger later)	**Pt(II)-porphyrin** dyes (e.g., **PtTFPP**, PtOEP) or **$Ru(dpp)_3^{2+}$** complexes (oxygen-quenchable phosphorescence)	**Core (embed)** or **inner shell**	**Embed during nanoprecipitation**; or conjugate via EDC/NHS to a PEG spacer and entrap	Signal intensity/lifetime **drops with higher O_2**; in hypoxia at the wound edge, signal **increases** → you can log hypoxia to validate targeting
Ca^{2+} (reporter now)	**Fluo-4**, **Fura-2**, **Oregon Green BAPTA-1** (available as **dextran-conjugates** for better retention)	**Core (embed)** or **surface via PEG spacer**	Embed or conjugate via **EDC/NHS** to PEG-amine; use **BAPTA-type** indicators	Fluorescence **increases** when local **Ca^{2+} > ~2–2.5 mM** (platelet activation/tissue rupture zones) → supports release decision logs

Fibrin proximity (optional add-on)	**Fibrin-binding peptide** (**CREKA**) or **GPRP**-based motif; or **anti-fibrin aptamer**	**Surface**	**EDC/NHS** or **maleimide–thiol**; add a short **PEG$_{1}$k–$_{2}$k** spacer to avoid steric hindrance	Provides **local enrichment** at forming clots; can be combined with thrombin gate for even more specificity

Notes:
• Thrombin peptide sequences above are widely used in drug-delivery literature; pick one validated in plasma.
• Hydrazone/acetal linkers hydrolyze in mildly acidic environments—tune rate by linker choice.
• Pt-porphyrins and Ru-complexes are standard O_2 probes (lifetime-based is best for quantitation).
• Fluo-4/Fura-2 are workhorse Ca^{2+} indicators; dextran-conjugated forms reduce leaching.

How the combined trigger works (step-by-step)

1. **At baseline** (normal blood): thrombin low; pH ~7.4; O_2 normal; Ca^{2+} ~1–1.3 mM.
    - **Thrombin gate closed** (peptide intact). **pH gate stable.** Minimal bleed of cargo.
2. **At hemorrhage site:** thrombin spikes; micro-environment pH drops; transient hypoxia; Ca^{2+} rises locally.
    - **Thrombin cleaves the peptide cap** → pores open.
    - **Low pH accelerates cap hydrolysis** (hydrazone/ketal), further opening.
    - **Cargo releases rapidly**; Ca^{2+} & O_2 reporters confirm microenvironment for QA/telemetry.
3. **Away from wound:** no thrombin spike, no sustained acidosis → caps remain **closed**, avoiding off-target release.

Practical build recipe (MVP you can run with a polymer lab)

1. **Make PLGA particles with platelet payload**
    - Nanoprecipitation or double emulsion (w/o/w) with **PLGA-PEG-COOH**.
    - Co-embed **O_2 dye** (PtTFPP) and **Ca^{2+} dye** (Fluo-4 dextran).
2. **Install a short PEG brush** for colloidal stability (2–5 kDa).
3. **Conjugate thrombin-cleavable peptide caps**
    - Use **PLGA-PEG-maleimide** and a **Cys-terminated peptide** (Thrombin-cleavable sequence).
    - Add a small **PEG cap** through the peptide so cleavage physically uncaps pores.
4. **Add pH-labile linkers in parallel**
    - Incorporate **hydrazone** (or ketal) linkage in some fraction of caps for **dual gating**.
5. **(Optional) Add fibrin-binding motif** on a minority of surface PEG chains to **enrich at clots**.
6. **QC**: DLS (size/PDI), zeta potential, peptide density (TNBS or fluorescamine), dye loading (UV-vis), peptide cleavage kinetics (thrombin assay), release profiles at pH 7.4 vs 6.6 ± thrombin.

Why not use Ca^{2+} or O_2 as primary *release* gates right now?

- **Ca^{2+}:** Baseline blood Ca^{2+} is already high (~1–1.3 mM). Designing a gate that **stays closed** at baseline yet **opens only >2.5 mM** is possible (e.g., calmodulin–M13 conformational uncapping), but it's more fragile and less mature than thrombin/pH gates. Use Ca^{2+} **as a reporter** in v1.

- **O_2:** Hypoxia-reduction linkers (e.g., **nitroimidazole**, **azo**) exist, but **biological reduction kinetics in blood** are variable. Keep O_2 **as a reporter** for now; consider hypoxia-labile linkers in later iterations.

TL;DR build plan

- **Do now (robust):** Thrombin-cleavable peptide cap + pH-labile linker **for gated release**; embed **Pt-porphyrin** (O_2) and **Fluo-4** (Ca^{2+}) **as reporters**.
- **Attach via: EDC/NHS**, **maleimide–thiol**, or **click** on **PLGA-PEG**.
- **Validate:** Release only at **high thrombin + low pH**; log O_2/Ca^{2+} to prove you were at the bleed site.

August 26th 2025:

- Compared PLGA vs PCL nanoparticles as well as examined how a coating could be used for protection

PLGA & PCL Nanoparticles

PLGA: the fast degrading chain

- PLGA is basically a polymer made from two blocks lactic acid + glycolic acid
- picture it like a beaded bracelet blue beads = lactic acid red beads = glycolic acid you can mix them in different ways to control how fast the bracelet falls apart in your body
- more glycolic acid = breaks down faster red beads are weak
- more lactic acid = breaks down slower blue beads are tough
- when PLGA breaks down it just turns into stuff your body can handle like water and CO2 super safe
- end of the polymer sometimes has a tiny negative charge but the chain itself is neutral

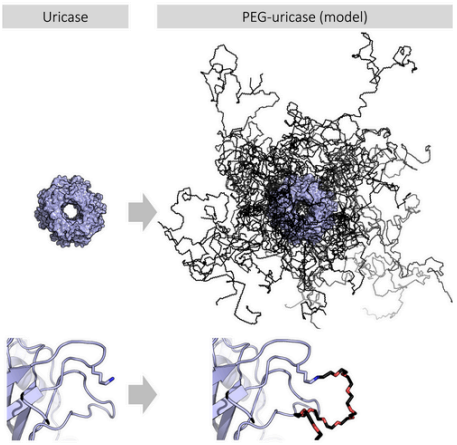
PCL: the slow mo polymer

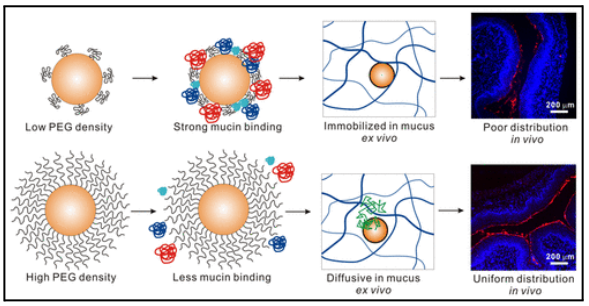
- PCL is way simpler made from just one kind of building block caprolactone
- think of a long squishy yellow noodle very flexible very hydrophobic repels water
- breaks down super slowly months to years perfect if you want a drug to release really slowly
- because of this, deffo not perfect for us :(
- also neutral so no natural positive charge here either

PEGylation: the invisibility cloak

- PEGylation = coating your nanoparticles with PEG chains which are like long water loving spaghetti strands

- what PEG does
    - stealth mode hides from the immune system so nanoparticles stick around longer
    - stability boost prevents them from clumping.





    - neutral vibes surface becomes more hydrophilic and less negative.

Encapsulation: how we load platelets

- encapsulation = trapping a drug inside our polymer nanoparticle so it can travel safely in the body.
- main methods
    - emulsion single or double
        - mix polymer + drug in a solvent
        - shake it into water forms droplets solvent evaporates nanoparticles
        - single emulsion hydrophobic drugs
        - double emulsion hydrophilic drugs
    - nanoprecipitation
        - dissolve polymer + drug in a water friendly solvent drop into water polymer collapses around drug
        - quick & simple
    - spray drying
        - spray the polymer + drug solution into hot air solvent evaporates dry nanoparticles
        - good for making lots at once
- things that affect encapsulation
    - polymer type PLGA vs PCL
    - drug type water loving vs water hating
    - how you mix & stir stuff
    - size of particles smaller particles = faster release usually

comparison

- feature: PLGA vs PCL

    - blocks: lactic + glycolic vs caprolactone only
    - degradation: fast ish weeks to months vs slow months to years
    - drug type: hydrophilic & hydrophobic vs hydrophobic mostly
    - charge: neutral vs neutral
    - PEGylation: can be coated vs can be coated

September 4th 2025:

- Worked on developing a first phase protocol for testing the platelet component of ClotGuard (not validated):
    - Verify that the freeze-drying process preserves platelet morphology and functional markers after rehydration.
    - Measure **rehydration kinetics** and **functional recovery** (do platelets regain aggregation/adhesion ability and receptor presentation).
    - Quantify **clotting efficacy** of the rehydrated material across a range of simulated hemorrhage severities and tissue environments.
    - Demonstrate stability of FD platelet material under relevant storage conditions (shelf life, transport vibration, humidity).

September 24th 2025:

- Had a meeting with Ejaife Agbani from the University of Calgary to further validate the use of our freeze-dried platelets and how we could potentially test in the future

Ejaife Agbani

Summary of meeting:

Main Takeaways:

- **Freeze-drying methods** → We need to take a close look at the different ways this can be done. From there, we can narrow down the ones that make the most sense for what we're building.
  Biocompatibility always matters → We have to keep in mind how the body might respond (immune system, cytotoxicity, etc.). Over-clotting vs. under-clotting is going to be a big consideration since we're adding something on top of natural platelets.
- **Research first, then build protocols** → We should go through papers on freeze-dried platelets, especially veterinary ones (since those are already being done and can prove the method works). That'll help us design lab protocols and avoid obvious mistakes. Also important to note: a lot of these use *non-phosphorylated platelets*.
- **Nanotech connection** → We should check how this whole idea could line up with nanotechnology.
- **Circulation dynamics** → In the body, millions of platelets are floating around. Because red and white blood cells are bigger, they push platelets to the sides

of blood vessel walls. That's where platelets stay "on guard" scanning for places to patch up. We also need to think about how plasma and other parts of blood come into play.

- **Activation speed** → Freeze-dried platelets take ~4–5 seconds to activate. How does that compare to regular platelets? Could this delay matter when blood loss is happening fast?
- **Big questions we need to answer:**
    1. What role are freeze-dried platelets *really* playing once inside the body?
    2. How do they fit into the body's already well-orchestrated clotting system?
    3. How do we prevent too much clotting… or too little?
    4. Once rehydrated, how viable are they?
    5. What's the absolute best way to freeze-dry them?

- **Lab space options:**
    1. **Work under a PhD holder** → They'd act as a mentor, check our protocols, and possibly give us lab access.
    2. **Go independent** → Just ask for lab space directly, bring our own materials, and run everything ourselves.

October 9th 2025:

- Developed a timeline for ClotGuard in the form of a one-pager that we can send and present to people
- Prepared for meeting with Microsoft on October 10th

October 10th 2025:

- Had a meeting with Microsoft (Cindy Hui and Greg Carnie) about ClotGuard and how they can support us
- Discussed using resources at Microsoft to develop the patch/sensors for ClotGuard
- Discussed the labs that we need and where we see ClotGuard going in the future
- Said to keep in touch and see how they can support us in the future (talk internally to see what's there for us)

October 15th 2025:

- Brainstormed some ideas to try and find nanocarrier alternatives (some people are hesitant about nanotechnology, which can make development slower)
- Nanobots right now are not able to do 'self-propulsion', the entire basis of our project essentially, and likely won't be for about 5-10 years, unless we focus solely on that development
- Nanobots also are not able to propel themselves fast enough (or slow down) to precisely bind and attach to an area of definite injury
- Nanotechnology development remains in early stages, and likely will be, for the next couple of years, so being able to test our specific nanotech would likely be a struggle

Proposed alternate idea #1: Xenobots

- Xenobots: similar to nanobots, xenobots are essentially nanorobots that are developed through the use of stem cells of embryos of organisms such as frogs (most commonly)
- Xenonbots could be an advantage, as we can essentially add whatever traits and characteristics that we need and make our own kind of nanobots
- Disadvantages come with anything, as always, so this could also set us back further; we just need to be extremely careful with how we create this
- In some aspects, this is similar to CRISPR-engineered organisms, but it's a much easier process, as there is more developing research, rather than nanobots within the body
- To add, there is also limited information/research/clinical trials being done on humans related to nanotechnology, so this would be another hurdle to jump

Proposed alternate idea #2: Pill

- Instead of having a patch disperse nanobots throughout the body, another alternative that we came across was orally consuming a pill, filled with PLGA nanoparticles, which encapsulate freeze-dried platelets (also coated with PEGylation to avoid immune response)
- The PLGA nanoparticles, in theory, could work if swallowed beforehand, because they are designed to only ‘zip open’ and release the payload when biomarkers of intense bleeding are detected (such as p-selectins, thrombin, collagen, elastin, proteins in general, and activated platelets).
- The only issue with this is that if you do not end up bleeding out, would the nanoparticles remain in your body forever? How can we program PLGA nanoparticles to open up in minutes under specific conditions? Could this be solved by having both a patch AND a pill? What would that look like?
- Solution proposed by CGP: Inactivation of platelets until release
- You could coat freeze-dried platelets with a protective polymer or inhibitor that prevents them from activating until the PLGA is triggered
- Essentially, platelets only “wake up” in the bleeding microenvironment
- Technically could work in my opinion
- Patch features: Signals
- The patch could also detect how many platelets are needed for the situation, and assess it accordingly
- Through this, it would send the amount of platelets needed, no extreme amounts, and no extremely low amounts
- Once the patch detects the bleeding, it can estimate where the bleeding is occurring—this would be great, as we could probably send out the signals to that area for the nanobots to go to
- Even better, we could have multiple patches on the body. Once the patch detects where the bleeding is happening, it will guide the nanobots to the nearest patch
- CGT suggested: Hybrid system
- Use patch EM signals to roughly guide nanobots to the right body region.
- Nanobots then switch to biomarker chemotaxis for precise navigation to the bleeding site.

Chat Convo:

Step 1: Patches continuously monitor for bleeding
Setup: Multiple ClotGuard patches are placed on strategic parts of the body (arms, legs, torso).
Sensors: Each patch has biosensors to detect key bleeding biomarkers, such as:
Thrombin
P-selectins
Activated platelets
Fibrin or collagen fragments
Signal processing: The patch analyzes biomarker levels in real-time. A sudden spike indicates active bleeding nearby.

Step 2: Patch identifies the “hotspot”
When bleeding is detected.
The patch compares biomarker intensity across all patches.
The patch with the highest concentration determines the approximate location of the bleeding site.
The patch estimates how much platelets or nanobot payload are needed based on biomarker levels and rate of detection.

Step 3: Patch emits a guidance signal
The selected patch emits a guidance signal to circulating nanobots. Options include:
Electromagnetic (EM) signals (low-power radio waves, similar to RFID)
Ultrasound signals that nanobots can detect
Localized chemical cues (small, biocompatible molecules that amplify natural biomarkers)
The signal strength allows nanobots to approximate which patch is closest to the bleeding site.

Step 4: Nanobots respond to guidance signals
Navigation phase 1 (rough guidance): Nanobots detect the strongest signal and start moving toward the corresponding patch.

Navigation phase 2 (fine-tuning): As nanobots approach the general area:
They switch to chemotaxis, sensing local bleeding biomarkers (like thrombin, collagen, fibrin).
This ensures nanobots home in precisely on the bleeding site.

Step 5: Platelet delivery
Nanobots carry freeze-dried platelets encapsulated in PLGA:
Platelets remain inactive while circulating to avoid accidental clotting.
Upon detecting high biomarker concentration at the bleeding site, PLGA nanoparticles open rapidly, releasing platelets.
Protective coatings or inhibitors on the platelets ensure they only activate in the presence of bleeding biomarkers.

Step 6: Controlled response
The patch monitors the effectiveness of clotting:
If bleeding decreases, it reduces signal strength, slowing further platelet delivery.

This prevents over-clotting or unnecessary platelet release.

Step 7: Biodegradation and cleanup
PLGA nanoparticles degrade after payload release.
Any unused nanoparticles gradually degrade over a preset period (hours to days), minimizing risk of unintended clotting.
Nanobots could also be programmed to self-deactivate or exit the bloodstream after completing their mission.

Key Features of the Hybrid System
Multiple patches: Act as “beacons” and monitor local biomarkers.
Hybrid guidance: EM/ultrasound for rough navigation + chemotaxis for precise targeting.
Controlled platelet delivery: Only release platelets where and when needed.
Safety: Nanobots and PLGA degrade safely; platelets remain inactive until triggered.
Feedback loop: Patches monitor bleeding response and adjust guidance dynamically.

✅ In essence:
Patches = detectors + navigational beacons + feedback controllers
Nanobots = carriers + precision delivery agents
Platelets = payload, only active at the bleeding site
This creates a real-time, closed-loop system for rapid, targeted clotting with minimal risk of systemic side effects.

October 16th 2025:

- Had a meeting with Sara Akbarzadeh, who works in medical devices/wearables at the FDA
- She helped guide us on how future FDA work would look like for ClotGuard
- Said everything looked relatively fine upon a “preliminary examination” and realistic to put together as a device
- She said it would be a class 2 device (no risk/mild risk) and that

October 24th 2025:

- Had meeting with Noah Smith from Front Row Ventures who works in IP
- Talked to him about where we are at with ClotGuard and explained the different things we’ve heard about IP
- Told us to hold off until way later when we have the confirmed idea and we won’t be pivoting
- Put ClotGuard on file to see how else they can support us besides funding (not eligible yet)

October 27th 2025:

- Put together some links for non-dilutive funding options

Accelerating Innovations into CarE (AICE):
https://albertainnovates.ca/funding/accelerating-innovations-into-care-aice/

Industry r&D Associates Program:
https://albertainnovates.ca/funding/industry-rd-associates-program/

Micro Voucher Program: https://albertainnovates.ca/funding/micro-voucher-program/

(Must be incorporated) Voucher Program:
https://albertainnovates.ca/funding/voucher-program/

Innovative Medicines Canada:
https://innovativemedicines.ca/contact/sponsorship-applications/

October 29th 2025:

- Met with Jeff Ryzner UofC and Reiner Deurwaarder KPGM to talk more about ClotGuard and what we are working on
- Asked about connections to labs or other companies working on this tech
- Set up a future meeting with Jeff and got some more info from Reiner

November 19th-20th

- Attended the Future Summit in Calgary and made many connections with people interested in ClotGuard and looking for ways to support us

November 23rd 2025:

- Met with Pablo Guzman who works in material science to help give us some more insight on ClotGuard (technical validation, etc.)
- Explained the core concept of the material science for ClotGuard
- Asked him about different storage/delivery methods and materials/mechanisms to use
- Validated our product again (had met with him once previously) and gave us some good info for future development

Clotguard Meeting Brief

ClotGuard Nanobot Patch – Expert Meeting Brief

🧠 Overview

This document summarizes the key ideas, questions, and mechanisms behind **ClotGuard**, your smart microneedle patch concept. It's written in a clean, professional, and easy-to-explain style so you can confidently discuss it with a biomaterials expert.

1️⃣ Core Concept

ClotGuard is a smart microneedle patch that:

- **Detects bleeding automatically** using biochemical and mechanical sensors.
- **Releases PLGA-encapsulated nanobots** carrying freeze-dried platelets or clot-promoting molecules.
- **Delivers nanobots directly into dermal capillaries** through microneedles.
- **Creates rapid, localized hemostasis** by sending clotting agents only when and where an injury occurs.

Goal: immediate hemostasis within **seconds**, without user action.

2️⃣ Key Questions & Insights

Q1: Can we add P-selectin or collagen receptors to PLGA-encapsulated platelets?

Answer: Yes, theoretically.

- P-selectin and collagen receptors can be **ligand-conjugated** or **protein-coated** onto PLGA surfaces.
- This lets nanobots bind to exposed collagen or activated platelets at the injury.
- Effect: **faster targeting, stronger adhesion**, and more natural clot formation.

Q2: If delivered by pill, how long would ~300,000 nanoparticles take to reach the bloodstream?

Estimated: 15–45 minutes, because of:

1. Intestinal dissolution.
2. Absorption into bloodstream.
3. First-pass metabolism (causes loss).
4. Once in the blood, circulation happens fast (~1–2 min).

Limit: Slower than a patch. Not ideal for emergencies.

Q3: Could multiple patches improve response time?

Yes. A distributed, multi-patch system:

- Increases coverage across the body.
- Allows the closest patch to activate first.
- Provides redundancy—other patches release secondary waves if needed.

Q4: What if the injury happens far from the patch?

A single distant patch is **less effective** because:

- Local thrombin or flow changes won't be detected.
- Nanobots must travel farther through bloodstream.

Solution: multi-patch network.

Q5: Can each patch give a "big dose" first, then smaller doses later?

Yes — optimal strategy.

- Nearest patch releases a **burst dose**.
- Other patches release **support doses** seconds/minutes later.
- Balances **rapid clotting** with **systemic stability**.

3️⃣ Microneedle Patch Mechanism

How It Works

1. Sensors detect biomarkers: thrombin, fibrin, hemoglobin, oxygen, or pressure.
2. Microneedles pierce the outer skin painlessly.
3. Nanobots enter **dermal capillaries**.
4. Nanobots rapidly travel to wound site.

Trigger-to-release speed: seconds → ~1–2 minutes.

Sensor Types

- **Thrombin sensors:** detect local clotting signals.
- **Hemoglobin sensors:** detect bleeding.
- **Flow/pressure sensors:** detect vascular damage.
- **Multi-signal detection = highest accuracy.**

4️⃣ Why Thrombin Alone Isn’t Enough

- Thrombin spikes **locally**, not systemically.
- Distant patches won’t sense thrombin from small injuries.
- **Multi-signal detection** (thrombin + hemoglobin + flow) is more reliable.

5️⃣a Capsule-on-Patch Concept

Can the patch hold a capsule that releases nanobots when triggered?

Yes — and it’s very feasible.

How It Works

- A capsule/reservoir is mounted on the patch.
- Stores nanobots (liquid or freeze-dried).
- When sensors detect bleeding, the capsule:
    - **Opens**, or

    - **Pumps contents** into microneedle channels.
- Nanobots flow into bloodstream immediately.

Advantages

- Larger storage capacity.
- More stable nanobots.
- Multi-stage/controlled dosing.
- Faster delivery.

Challenges

- Requires micro-pumps, valves, or dissolvable membranes.
- Slightly more complex engineering.
- May need a micro-power source (or passive mechanical actuation).

6️⃣ Summary Table

Concept	Description
Triggered release	Sensors activate nanobot deployment instantly.
Local vs systemic thrombin	Thrombin is local → multi-signal detection is better.
Multi-patch system	Faster detection because one patch is always near injury.
Capsule-on-patch	Higher payload + controlled release.
Time to effect	Detection to delivery: seconds → full effect in 1–2 min.

7️⃣ Future Design Considerations

- Improve sensor combinations (thrombin + hemoglobin + flow detection).
- Build safe actuation for capsule-based release.
- Test ligand-coated PLGA nanobots (P-selectin, collagen-binding).
- Design optimal dosing strategy: **local burst + systemic follow-up**.
- Integrate microelectronics or energy-harvesting tech for autonomous function.

🧪 What You Can Ask the Expert

Here are great questions to bring into your meeting:

- **Is chitosan still the best material for nanobot coating or should I optimize the PLGA blend?**
- **How feasible is integrating micro-pumps into a microneedle patch at this scale?**
- **What challenges exist with freeze-dried platelet stability inside micro-reservoirs?**
- **Would ligand functionalization (like P-selectin) significantly improve targeting in real tissue?**
- **What microneedle materials would you recommend that balance strength, dissolvability, and biocompatibility?**

Thrombin sensing chemistry, electrochemical sensors, microneedle electrode, fibronectin, collagen, elastin, self-sampling, fluid flow, hemoglobin detection

ClotGuard x Pablo — Technical Meeting Notes

1. Overview of the 3 Microneedle Architecture Options

Option 1 — PEG/PLGA Payload in Dissolvable Microneedle Tips (Safest + Most Feasible)

Structure:

- Small discrete PLGA nodules loaded into the tip of dissolvable microneedles.
- Can also be made as core–shell particles, but scaling that is harder.
- Thrombin-sensitive peptide or hydrogel coating controls release.

Pros:

- Simple mechanical deployment (pressure patch).
- Good for local delivery.
- Materials + architecture are very well studied → fewer unknowns.
- Most reliable for the type of sensing ClotGuard needs.

Cons:

- Chemical trigger must be highly selective or risk false releases.
- Still, false-release risk is manageable for ClotGuard's use case.

Team consensus:

- This is the best option for ClotGuard.

Option 2 — Separable Capsule System (Modular Cartridge)

Structure:

- Microcapsules sit in wells connected to dermis via microneedles.
- Payload cartridges can be swapped out per dose.

Pros:

- Modular; easy to replace or change payloads.
- Useful if multiple doses or different drugs needed.

Cons:

- Very complex: microvalves, flexible electronics, sealing systems.
- Premature releases are more catastrophic than in Option 1.
- Not aligned with full autonomy + zero maintenance goals.

Team consensus:

- Hard no — conflicts with ClotGuard being fully autonomous.

Option 3 — External Device Trigger (Ultrasound/Magnetic)

Structure:

- Microneedles + PLGA payload activated by an external handheld device.

Pros:

- No biochemical false positives → very controlled release.
- Strong scalability for hospital settings.

Cons:

- Requires external hardware → logistics nightmare.
- Extra training + complexity.
- Risk of environmental triggers (ultrasound, magnets, etc).

Team consensus:

- Interesting for hospitals, but not suitable for current ClotGuard product.

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2. Sensing Modalities for Option 1

A. Enzyme/Marker Sensing (Focus Area)

Biomarkers discussed:

- Thrombin (biggest priority)
- Fibrin / FDPs
- Elastin
- Collagen fragments

Thrombin = most promising + most researched for enzyme-cleavable systems.

Need deeper dive (Pablo said not his specialty but high potential).

B. Electrochemical Sensors

- Micron-scale electrodes sampling interstitial fluid.
- Detect thrombin, FDPs, other clotting markers.
- Low power + continuous sensing.

- BUT ↑ electronics complexity.

Recommended to explore: ISF (interstitial fluid) self-sampling electrodes.

C. Mechanical / Pressure Sensors

- Detect sudden local pressure/flow changes from bleeding.
- Simple and non-specific.
- Not reliable alone → best as secondary sensor.

D. Hemoglobin/Blood Presence Detection

- Colorimetric/optical.
- Not super reliable but worth reading for extra context.

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3. Triggering Mechanisms for PLGA Release

1. Enzyme-Degradable Coatings (Best Fit)

- PLGA nanoparticles coated with thrombin-cleavable hydrogels or peptides.
- Most researched method; strong biomedical track record.
- Aligns perfectly with ClotGuard's "biochemical release" goal.

2. Core–Shell Microneedles

- PLGA core + dissolving shell.
- Similar concept but alters microneedle structure.
- Not ideal for Option 1 architecture.

3. Mechanical Rupture / Micro-Actuators

- Sensor detects trigger → miniature actuator ruptures capsule.

- Reduces false positives but massively increases complexity.

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4. Discussion on Pumps + Alternative Architectures

Micro-pumps inside patch?

- Possible but:
    - Greatly increases manufacturing difficulty.
    - Microneedles naturally dissolve → hard to time with pump actuation.
    - Overkill for your use case.

Conclusion:

→ Stick to chemical (biomarker) triggering, not pumps.

Microneedle Patch + Storage Capsule on Top

- Patch at bottom, storage module on top that holds PLGA payload.
- When triggered, payload flows through microneedles.

Pablo's take:

- Yes, totally possible.
- Adds some complexity (now becomes two-component system).
- Storage may be easier and electronics can be housed above.

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5. Manufacturing Considerations (For Later)

Currently:

- Team is focusing on platelet behavior + validating core science.
- Manufacturing will be complex and expensive, but it's a second-stage problem.

Future discussion topics (to cover later):

- Patch fabrication methods
- Material selection
- Process diagrams
- Scaling

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6. Team’s Alignment

- Both Sophia & Isa strongly prefer Option 1.
- Option 2 contradicts full automation goals.
- Option 3 only makes sense for hospitals, not consumer wearables.
- PLGA encapsulated payload loaded into the tip of the microneedle

Pros: not many unknown
Cons: You're going to have false releases if the coating of the microneedle structure isn't proper

- Seperable capsule, discrete microcapsule of PLGA sits in wells in a patch, can connect to the dermis via microneedles

Pros: modular, can swap out payload from needle if desired, centralizes everything, can be more customizable of the cartridge and the product
Cons: going to be complex, have to deal with different components and need to have robust healing

- An actuator is an external trigger (ultrasonic, magnet), to not have to worry about false positives or the chemical release, and have more control over when the drug releases

Cons are that it complicates autonomy, external devices, and workflow
It could work for hospital environments; it is a better option

Coat the microneedles with something thrombin sensitive for release

Triggers and sensing modalities

- Thrombin-responsive chemistry has a lot of research, but it's probably our best bet
- Electrochemical sensors are able to detect small markers and are low-powered and continuous, but they do complicate the structure, which is helpful
- Mechanical or pressure sensors, a sudden increase in fluid flow is simple and not specific, helps to detect blood flow and could be an external biomarker
- Hemoglobin

PLGA Encapsulation

- Enzyme-degradable coatings to coat your PLGA nanoparticles, when exposed to an enzyme, they start diffusing and can release, most researched and is covered
- Coreshells microneedles, PLGA core with dissolving shell, something to keep in
- Chemical rupture, when the sensor detects a trigger, the mini actuator can break the membrane to release the payload, reducing false positives, but increasing complexity

November 27th 2025:

- Had an in-person meeting/tour with Jeff Ryzner of the Hunter Hub for Entrepreneurial Thinking to further discuss ClotGuard and meet another connection, Paula Berton
- Showed lots of enthusiasm for working with us on this and getting testing actively moving
- Gave Paula an overview of ClotGuard and she validated it saying it is completely plausible, just need to do more research on her end to better understand where to help us
- Confirmed a collaboration with them as well

November 29th 2025:

- Sent over to Paula our estimated ClotGuard testing roadmap for her to look over, give feedback on, and help her determine next steps

Phase	What we are testing	Why	Literature Reviews
1	Rehydration kinetics and morphology	- Verify freeze-dried platelet units rehydrate in an acceptable short window and return to near-normal morphology - An acceptable short window would need to be determined based on the time it would take for the encapsulation of the platelets to degrade - Compare these platelets to synthetic platelets, contrasting the two to see which could work better in our specific environment, which is set for them	- Freeze-dried platelets are a promising alternative in bleeding thrombocytopenic patients with hematological malignancies - PubMed - Towards a Clinical Application of Freeze-Dried Human Platelets - Human platelets loaded with trehalose survive freeze-drying - PubMed - Wound-healing properties of trehalose-stabilized freeze-dried outdated platelets - PubMed - A potential game-changer for emergency medicine: synthetic platelets | NHLBI, NIH - Synthetic Platelets:

			- Nanotechnology to Halt Bleeding - PMC - Synthetic platelets stop bleeding in animal studies | National Institutes of Health (NIH) -
2	Aggregation/thrombin generation/simple clot mechanics	- Make sure the platelets still have functional clotting capability - Check the effect on clotting formation in whole blood during wound - This will help determine the payload amounts that the patch would administer, maybe based on the size of wounds and more specific biomarker levels?	- Freeze-dried platelets promote clot formation, attenuate endothelial cell permeability, and decrease pulmonary vascular leak in a murine model of hemorrhagic shock - PubMed - Mechanisms of action of an investigational new freeze-dried platelet-derived hemostatic product - ScienceDirect - Mechanism Action of Platelets and Crucial Blood Coagulation Pathways in Hemostasis - PMC - Studies on synthetic peptides that bind to fibrinogen and prevent fibrin polymerization. Structural requirements, number of binding sites, and species differences | Biochemistry
3	Encapsulation candidates and rationale	- Test different encapsulation methods (PLGA, including others) to see what works best - Test things such as the speed of degradation, the accuracy of degradation based on the biomarkers attached to the encapsulated particles - Make sure triggered release works	- Recent Applications of PLGA in Drug Delivery Systems - PMC - Poly Lactic-Co-Glycolic Acid Nano-Carriers for Encapsulation and Controlled Release of Hydrophobic Drug to Enhance the

		accurately, where the particles stay closed while travelling through blood, but immediately open in a bleeding environment	Bioavailability and Antimicrobial Properties - The drug release of PLGA-based nanoparticles and their application in the treatment of gastrointestinal cancers - ScienceDirect - PLGA-Based Drug Delivery Systems for Remotely Triggered Cancer Therapeutic and Diagnostic Applications - PubMed - Bioerodible PLGA-Based Microparticles for Producing Sustained-Release Drug Formulations and Strategies for Improving Drug Loading - Recent Applications of PLGA in Drug Delivery Systems - Degradation of Polymer Materials in the Environment and Its Impact on the Health of Experimental Animals: A Review - PMC - Ionized copolyesters with pH-responsive degradability: Accelerated degradation in specific environments - ScienceDirect - https://uwo.scholaris.ca/server/api/core/bitstreams/160af6bb-3d4a-4af2-95d9-f9907db170a5/content - Multi-stimuli-responsive polymer degradation by polyoxometalate photocatalysis and

			chloride ions - Nanoscale (RSC Publishing)
4	Patch sensors and storage of payload	- Test the storage method of the payload in the microneedles of the patch - Test the triggered release through the use of a biomarker measuring	- https://mae.ncsu.edu/zhu/wp-content/uploads/sites/13/2018/04/AdvMater2017.pdf?utm_source=chatgpt.com - Dissolving microneedles: Applications and growing therapeutic potential - ScienceDirect - Dissolving Microneedles for Transdermal Drug Delivery - PMC - Dissolving polymer microneedle patches for influenza vaccination | Nature Medicine - Incorporating surfactants into PCL microneedles for sustained release of a hydrophilic model drug - PubMed - Polymer microneedles fabricated from PCL and PCL/PEG blends for transdermal delivery of hydrophilic compounds - ScienceDirect - Implantable Microarray Patch: Engineering at the Nano and Macro Scale for Sustained Therapeutic Release via Synthetic Biodegradable Polymers
5	Nanobot delivery and accuracy	- Test how the nanobots can navigate the bloodstream - Test how they can identify different biomarkers to guide their delivery - Test the attachment of the	- Micro/Nanorobot: A Promising Targeted Drug Delivery System - PMC - Advances of medical

		encapsulated payload and the nanobots using linker molecules	nanorobots for future cancer treatments | Journal of Hematology & Oncology - Nanobots-based advancement in targeted drug delivery and imaging: An update - ScienceDirect - (PDF) NANOROBOTICS-BASED DRUG DELIVERY SYSTEMS: RECENT DEVELOPMENTS AND FUTURE PROSPECTS - Multifaceted applications of micro/nanorobots in pharmaceutical drug delivery systems: a comprehensive review - Nanorobots mediated drug delivery for brain cancer active targeting and controllable therapeutics | Discover Nano - Self-propelling, protein-bound magnetic nanobots for efficient in vitro drug delivery in triple negative breast cancer cells | Scientific Reports - Therapeutic applications of nanobots and nanocarriers in cancer treatment | Analytical Sciences - https://www.the-scientist.com/electric-fields-steer-nanoparticles-for-targeted-drug-delivery-73777 - https://pmc.ncbi.nlm.nih.gov/articles/PMC10347767/ - Self-Propelling Targeted Magneto-Nanobots for

			- Deep Tumour Penetration and pH-Responsive Intracellular Drug Delivery | Scientific Reports - Nanorobots inside a blood vessel for imaging and diagnosis (Microchips). | Download Scientific Diagram

December 3rd 2025:

- Reached out to all the new connections from the Future Summit about ClotGuard and future support
- Heard back from Jade Alberts, who sent links for other companies working in the space

http://mach32.net
https://www.difinity.ca/
https://nanotess.com/

- Had a meeting with Alexandra Ramadan from X, The Moonshot Factory, who judged the presentations in TKS back in May
- Validated our idea and wanted to work on it with us and support us by connecting us with labs
- Maintaining updates with her

December 6th 2025:

- Made a presentation and rehearsed for the TKS showcase this weekend to present ClotGuard and get connections for support

December 13th 2025:

- Presented ClotGuard at the TKS showcase and got a couple of connections that are interested in learning more about ClotGuard and supporting its development

December 14th 2025:

- Connected with Manoj Thacker, who's had a lot of experience working with startups and founders in the past, who expressed interest in learning more about ClotGuard and supporting it's development through speaking engagements
- Sent us a few potential speaking engagements for us and we sent over what looked best for ClotGuard

December 19th 2025:

- Had a preliminary meeting with Maleeka Malik from Uceed funds at the University of Calgary to discuss if we would be eligible for any of the grants offered
- Really liked the idea and wanted to set us up with two potential grant opportunities

January 2nd 2026:

- Heard back from Paula Berton about ClotGuard and her thoughts
- She sent over some preliminary literature reviews she's done for the first phase of ClotGuard testing, platelets and nanocarriers

- Went over the information together and messaged her back to let her know all her thoughts look good and we are good to mvoe forward whenever she is

January 5th 2026:

- Had a meeting with Maleeka Malik and the head of the Health Fund from UCeed, Jennifer Erickson, to see if ClotGuard is a good fit for the grant fund
- Got to explain ClotGuard and clarify any questions they may have about our plan or the idea

January 9th 2026:

- Received some questions to fill out in more detail from the people at the Health Fund about ClotGuard
- Worked on that and sent it out to them with more explanation on ClotGuard

January 16th 2026:

- Had a meeting with Maleeka Malik and Allison Swellin, who works in the other grant program, the Cenovus Grant, to see if ClotGuard would be a good fit
- Explained ClotGuard, clarified everything, and shared our future plans and the idea

January 21st 2026:

- Heard back from Maleeka that we moved onto the review phase for the Cenovus Grant and have our committee presentation scheduled
- Planning a meeting with Allison to learn more and go over the pitch

January 23rd 2026:

- Had a meeting with Karolina Krygier about the biochemistry of ClotGuard (specifically our PLGA nanoparticles and specificity)
- Validated our idea in saying that it all works logically and we've thought of a lot of the questions she already had
- Learned a bit more about the different ways to increase specificity for ClotGuard as it's travelling through the bloodstream

February 1st 2026:

- Had a meeting with Brendan Samek from the University of Alberta about ClotGuard to share more on the idea and hear his thoughts, as he's had a lot of experience working and developing other startups
- Said he was excited about the idea and had connections in the military to send over to us
- Wanted to help support

February 2nd 2026:

- Had a couple of meetings today, one with the grant and one with Microsoft for next steps on collab
- Met with Allison Swellin from the Cenovus Grant to help us prep for our pitch
- Gave us some feedback on one of our existing decks and ways to modify it for the purpose of this pitch
- Met with some of our connections from Microsoft (Greg Carnie, John Westworth, Cody Church) to discuss a potential collaboration with Microsoft and ClotGuard and see how they can help us
- We explained our goals for the collab
    - Developing patch
    - Sensors
    - Adhesive
    - Fabrication
    - Design validation and expertise

- Were very enthusiastic about wanting to help us and confirmed a collaboration
- Definitely going to be able to help us with fabrication, looking internally to see who can help with design

February 7th 2026:

- Created our pitch deck for the Cenovus pitch
- Modified it using the feedback Allison gave
- Practiced for the pitch

February 9th 2026:

- Set up communication with Microsoft for the patch prototype

February 11th 2026:

- Met to do some ideation work for ClotGuard
- Made some small changes to the product and refined the technicals we are working with
- Have a “probably final” idea now

What is being delivered

- Lyophilized synthetic platelets encapsulated with thrombin-cleavable peptide coating
- Will be coated with anti-toxicity substances to prevent cytotoxicity (such as PEGylation, but not this one)
- How it moves
    - Relies mainly on passive flow, but is looking to utilize enzyme-based propulsion
- How it targets injury/How it avoids clotting elsewhere
    - Patch is tracking blood velocity, oxygen saturation, blood pressure, and heart rate, and all 4 of these biomarkers need to be detected
    - Binds to exposed collagen, as it is the first exposed protein directly on the site of bleeding
    - The release of the platelets happens with the thrombin-activated cleavable peptide coating as well as the coating of the pH and calcium ions shell that, when detected, creates permeability (makes the shell less stabilized and faster to degrade)

1️⃣ Base Structure (the “platelet body”)

You need something:

- Biocompatible
- Biodegradable
- Stable after lyophilization

Strong options:

- **PLGA nanoparticles** (very common, controllable degradation)
- **Liposomes** (good for loading bioactive molecules)
- **Hydrogel microgels** (can swell at wound site)
- **Fibrin-mimetic polymers**

PLGA or hydrogel microgels for base, but need to test to determine.

2️⃣ Adhesion Enhancement (stick better than real platelets)

Real platelets bind to exposed collagen and von Willebrand factor (vWF).
You can enhance this by adding:

- **Collagen-binding peptides**
- **vWF-binding ligands (factor 5)**
- **RGD peptides** (bind integrins on natural platelets)

This increases recruitment and speeds clot initiation.

3️⃣ Aggregation Amplification (make clot grow stronger)

To boost clot strength:

- Add **fibrin-binding domains**
- Include **thrombin-generating triggers**
- Load **calcium reservoirs** (localized Ca^{2+} release enhances coagulation cascade)
- Add **ADP-mimetic molecules** to recruit natural platelets (test as add on in later phases)

You don't want systemic activation — only activation when exposed to injury markers.

4️⃣ Stimulus-Triggered Activation (precision control)

This is where you can be differentiated.

Trigger activation only when detecting:

- High thrombin concentration

You can design outer coatings that degrade in those conditions. Design a thin surface layer crosslinked with **thrombin-cleavable peptide linkers**.

When thrombin levels spike → linker cleaves → payload exposed within seconds.

That keeps it safer and more universal.

5️⃣ Universal Donor Considerations

To stay universal:

- No AB antigens
- No HLA markers
- Requiring the RH-negative factor
- No membrane proteins from donors

Pure synthetic or recombinant components are safest.

Avoid using actual donor platelet membranes unless fully stripped of immunogenic markers.

6️⃣ Shelf Life Engineering

You already mentioned freeze-drying — good.

To improve stability:

- Add **trehalose or sucrose**
- Use antioxidant stabilizers
- Keep components fully synthetic where possible

Lyophilized PLGA-based systems can last months to years if packaged properly.

February 14th 2026:

- Heard back from Paula with a more detailed overview of next steps for the first phase of testing
- Gave us some next steps for IP and funding, and is looking to connect with her further to talk in person about this
- Preparing to respond after reviewing
- Sent over materials for the patch prototype to Microsoft, as well as rough dimensions and design of patch

February 17th 2026:

- Rehearsed for the pitch on the 18th

February 18th 2026:

- Presented the pitch for the grant today
- Thought it went very well
- We'll hear results in a couple of days

February 19th 2026:

- Updated the ClotGuard website

February 20th 2026:

- Found out we got the $5000 grant
- Also earned us 9 advisory hours with one of our connections at UCeed
- Began planning for registering ClotGuard as a company in order to receive the funds

February 21st 2026:

- Did some promotional media work for ClotGuard
- Interviews, photos, etc.
- Updated our connections on ClotGuard funding results

February 23rd 2026:

- Set up a Fusion workspace for ClotGuard for Microsoft to access and start prototyping on

February 24th 2026:

- Researched and selected the microcontroller for prototype testing

February 25th 2026:

- Received outer patch prototype mockup for dimensions and scale
- Went to a pitch/networking event to connect with some people who may be able to provide funding for ClotGuard
- Followed up with Brendan for military connection and updated him on ClotGuard funding results

February 27th 2026:

- Sent over design requirements to Microsoft for the patch prototype (what the designs and mockups should look like and other design expectations)
- Had a meeting with Allison (UCeed advisor connection) to share updates on ClotGuard
- Received contacts from her to reach out to for funding
- Scheduled ClotGuard meeting for next week from the connections we made at the networking event
- Had a meeting with someone from a biotech consulting group to give a ClotGuard overview and receive feedback/next steps (another perspective)
- Updated our website further
- Did more research on incorporating ClotGuard (reached out to some people to discuss it) and registering it as a business
- Heard back from Brendan that he's working on getting the connections

February 2nd 2026:

- Fully updated the website and fixed all other changes

- Signed up for the pitch competition in March for the microgrant