

Massive Hemorrhaging

- Massive Hemorrhaging accounts for 12% of all fatal injuries in the US.
 - That is more than 18,000 annually.
- The survival time for a severe bleed is 5-7 minutes.
- EMS have an average fastest arrival time of 7 minutes.

Sprayable Hydrogel

- The hydrogel was formed from chitosan and the crosslinking agent genipin.
 - FDA approved.
 - Biocompatible with the human body.
 - Can be absorbed by the body.
- Mixing immediately forms a rigid hydrogel in less than 10 seconds.
- The hydrogel was formed by spraying chitosan and genipin from two different spray cans onto a single spot.

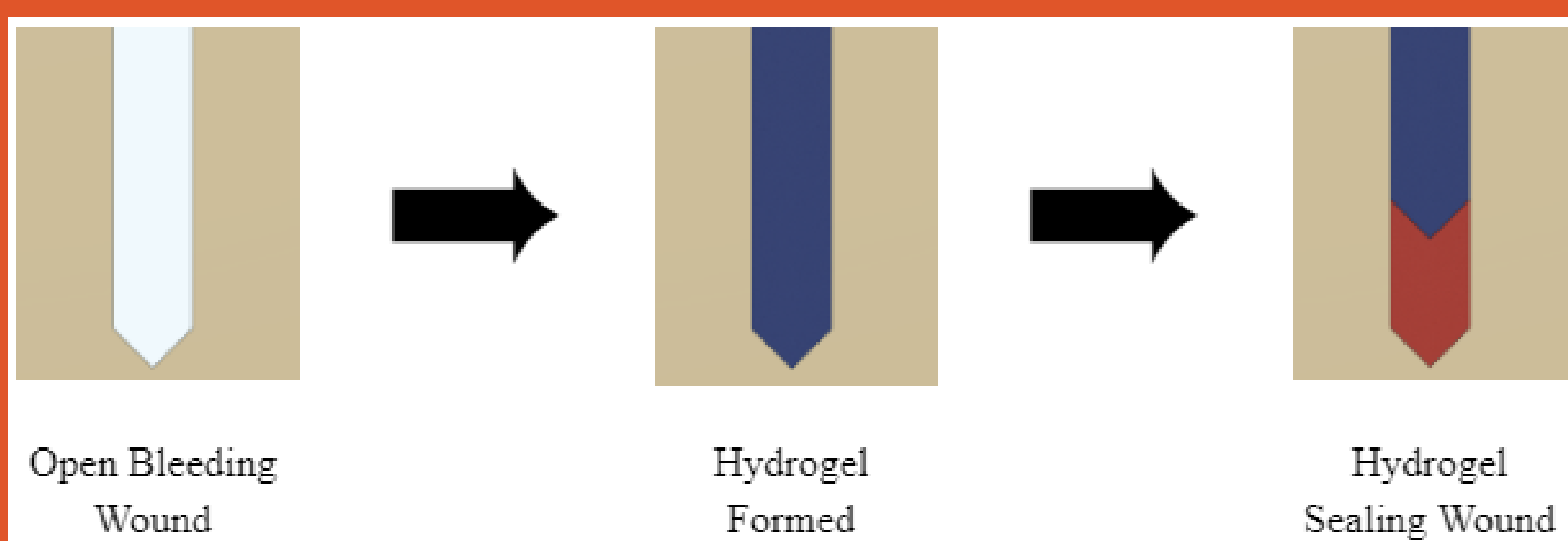
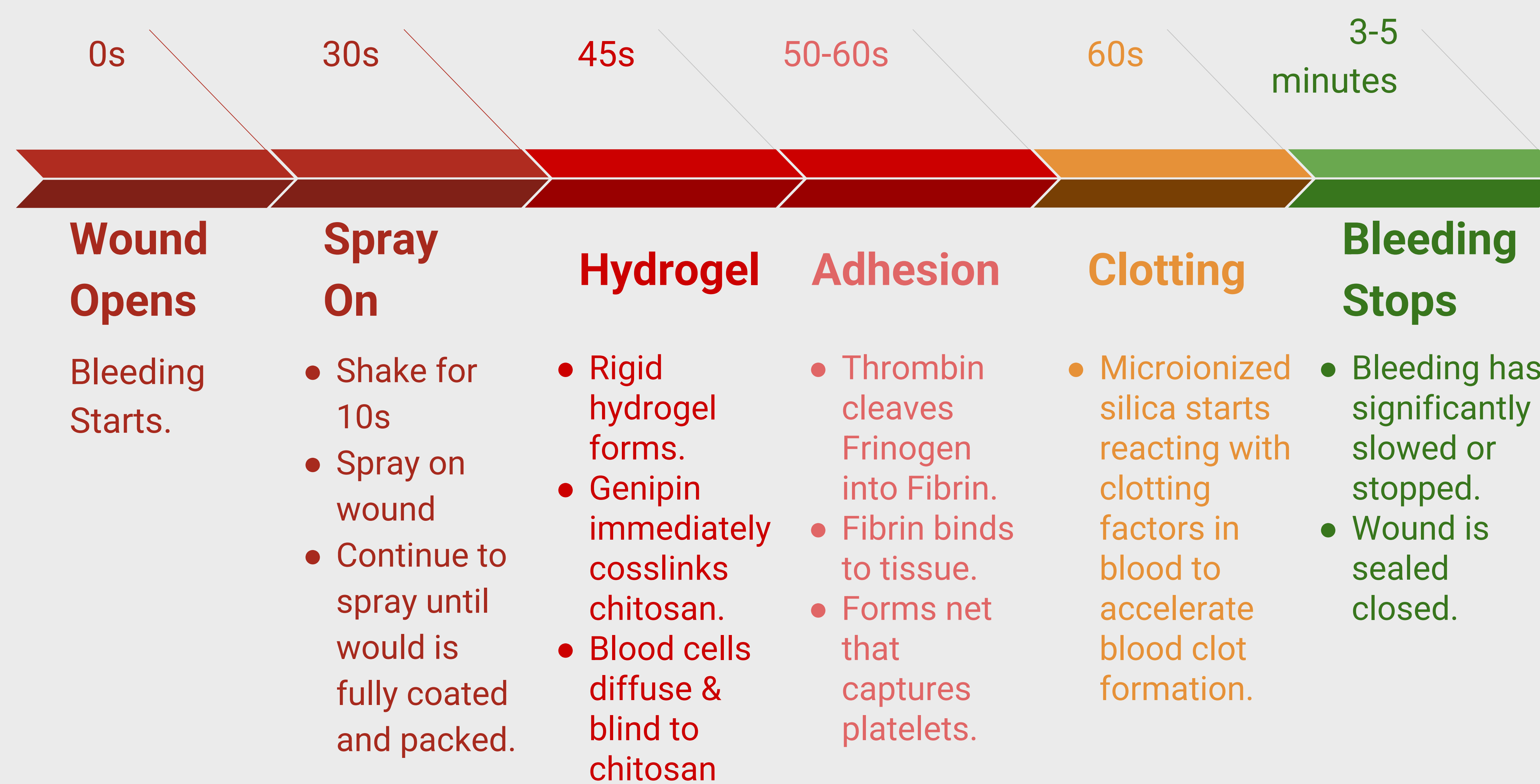


Figure 1. Diagram of blood diffusion into the hydrogel. The hydrogel can be injected into a wound before solidifying. Blood cells can diffuse and bind to the chitson blocking and slowing blood flow.

HemaHALT: Hemostatic Trauma Spray

An easy-to-use sprayable hemostatic hydrogel formed from chitosan and genipin that packs and seals the wound alongside tissue adhesives thrombin and fibrinogen and coagulant micronized silicon to decrease blood flow.

By Bryan Isherwood, Zachariah Dieringer, Leila Dopp, & Rachael Macdonald



Coagulant

- Micronized silica was selected as the coagulant.
 - FDA approved.
 - Biocompatible with the human body.
 - Can be absorbed by the body.
- Has a fast coagulation time in the presence of of thrombin and fibrinogen.
 - 3-5 minutes

Tissue Adhesives

- Thrombin & Fibrinogen were selected as tissue adhesives
 - FDA approved.
 - Biocompatible with the human body.
 - The natural reagents in the human clotting process.
 - Can be absorbed by the body.
- Reaction time of 20-30 seconds.
- Thrombin cleaves fibrinogen into fibrin, which binds to the surrounding tissue to form a mesh that traps platelets, thereby enhancing blood clot formation.

Final Product

- **HemaHALT** is a spray on hydrogel formed from **chitosan** and **genipin** that contains the coagulant **micronized silica** and tissue adhesives **thrombin** and **fibrinogen**.
- Fast application in under 30 seconds.
- Immediate blood flow reduction in 3-5 minutes:
 - Hydrogel forms in 10 seconds of mixing
 - Thrombin & fibrinogen react in 20-30 seconds.
 - Clot formation in 5 minutes facilitated by micronized silica.
- Estimated production cost: **\$33 per unit**.
- Bag-on-valve technology ensures sterility.



Figure 4. A rigid hydrogel was formed on the silicon test model when chitosan and genipin were sprayed from two different spray cans. Note that the hydrogel retains its form against gravity.



Figure 5. A display of a bag-on-valve pressurized spray can. The reagents will be stored in an inactive state in separate sterile bags. Any pressurizing agent can then be used.
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Acknowledgements:

We would like to thank Dr. Joe Baio, Rachel Thompson, Jade White, & Dr. Skip Rochefort of Oregon State University for assistance with this project