

Title: Dissolving Microneedle Vaccine Patch

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Project Description

An adhesive patch with a dissolving microneedle array designed to introduce vaccines to a person through the skin.

Project Summary

Bioengineers:

The project was to design a product that could deliver vaccines through a less painful mechanism than traditional hypodermic needles. Our solution to this was a patch with an array of dissolvable microneedles containing the vaccine within them. This transdermal process should be as effective as traditional injections without as many risks.

Using a biocompatible polymer, the vaccine could be stored in the needle and released when it comes in contact with viable tissue. The environment of the dermal layer would be suitable to trigger the dissolution of the structural crosslinks, freeing the vaccine trapped within. The vaccine disperses through the skin until it can be picked up through the dermal blood vessels, entering the bloodstream and then being transported throughout the body. The needle dimensions are set to avoid hitting the deep dermal nerve clusters, greatly reducing any pain signals. The dimensions should also have a large enough volume to carry enough vaccine for a full dose. The pore size left by the needles are smaller than traditional needles, reducing the risk of infection via microorganisms on the skin.

Application of the patch would theoretically take a few minutes and leave no sharps waste behind, making it easier to dispose of. The design also allows for anyone regardless of training to be able to apply it, including self-application. This would let the product be applicable by people with little training, lowering the barrier of entry for people to administer vaccinations compared to traditional hypodermic needles.

Public:

The dissolving microneedle vaccine patch works by allowing the vaccine to diffuse into the bloodstream through very small needles, called microneedles. These microneedles are so small—they're only about 1 millimeter tall—that you will hardly feel them pierce your skin. It's a lot less painful than traditional vaccines! Also, since the needles dissolve into the skin, there is no need to worry about any biohazards (contaminated needles). I'm sure we've all experienced the dreaded pain of having a long needle jabbed into our skin, but with the vaccine patch, the pain would no longer be an issue. Welcome to pain-free medicine!

This patch was designed with convenience and accessibility in mind while guaranteeing a pain-free experience. You don't even have to go to the doctor's office to have them administered! Going to visit the doctor is never a fun experience. You have to drive there, check in, wait in the waiting room, and typically go through a normal check-up before you get the vaccine. Luckily, the vaccine patch provides a wait-free experience. It's self administered, meaning that all you have to do is simply take the patch out of the packaging and place it on your arm. The vaccine only takes a few minutes to diffuse into the bloodstream, and then you're good to go! You can purchase the patch from your local pharmacy, such as Walgreens or Fred Meyer, and it's even possible to have the patch delivered directly to your door. Talk about convenience! If you feel uncomfortable administering the patch on your own, you're more than welcome to have it administered at the doctor's office, like with traditional vaccines, or have it administered at the pharmacy. The professional healthcare worker will simply place the patch on your arm and wait with you for a few minutes for the vaccine to diffuse.

Children and newborns can also use the vaccine patch! (Keep in mind that the vaccine patch presented here at the EXPO is the adult size—the size for children and newborns would be much smaller.) You would never have to experience taking your screaming child to the doctor's to get their vaccines ever again, earning you more freetime and extra peace and quiet!

The retail price of the vaccine would be about \$70-\$75 without insurance. We want to ensure that it's accessible for everyone, regardless of whether or not they have insurance. The vaccine patch may even be free in some cases, such as to help administer the COVID-19 vaccines. Accessibility is especially important—the more people that are vaccinated, the more often we can all live our lives disease-free.

Future patch developments include a patch that changes color after the vaccine has been administered as well as children's patches that have fun designs on them, such as their favorite animals and TV show characters! It's no doubt that the vaccine patch is an absolute game-changer. Say goodbye to long waits at the doctor's, painful needles, and screaming children and hello to pain-free, wait-free, and scream-free vaccines!

Grade Schoolers:

We understand that most people hate getting shots or vaccines and that needles can be scary. Because of this, we came up with a solution using a band-aid. Well, not exactly a band-aid, but it is pretty similar. Imagine a band aid, but, instead of the white pad in the middle being used to protect a cut, we cut that part out and replaced it with hundreds of tiny plastic needles that are barely long enough to cut through the top layer of your skin. The best part about the needles on the band aid is that they're painless and don't look more like velcro than needles. Inside each of these tiny plastic needles is the liquid used in the long needles for a vaccine shot, but instead of a liquid it's dry and hard. We did this by dissolving a chemical called PVP into water the same way that sugar dissolves in coffee or koolaid dissolves in water. We mixed this water with the PVP in it with the material of our choice and left it to dry into the small needles we wanted.

Now when the needles on the band aid enter your skin it dissolves like the PVP did in water, only this time the needles dissolve into your skin through the small holes they made. After a few minutes the dissolving is done and your shot is finished. We designed this band aid so you could leave it on after it's finished to protect your skin. We've been thinking of putting cool patterns, pictures from your favorite tv shows, or animals on these as well. Once you're done, just like any band aid you can take it off and throw it away like normal. Altogether, this is a cool new way to get rid of the scary and uncomfortable shots that most people need.