

DESIGN AND DEVELOPMENT

Creating a new, improved medical device is harder than it looks. A lot more planning, analysis and troubleshooting is involved to be able to produce a fully functioning product. Throughout the course of two terms at OSU, groups of seniors developed whole developmental processes for unique inventions determined by team members. The main process analyses were:

Identification of Opportunities

At the start of the year, students were allowed to define as many design opportunities as they could, focusing on prevalent medical issues rather than specific products. Our team was the most interested in opportunities that involved menstrual pain relief.

Product Selection & Target Market

After the identification of reliable opportunities, groups were tasked with choosing one specific product to expand upon. Starting with three main products, our group eventually decided on the transdermal patch because it was the most realistic option. From here, our group was tasked with defining our target market, which we determined were people with bad abdominal dysmenorrhea (period cramps).

Defining Customer Needs

After identifying the target market, our group had to further specify what that target market would expect from our design. While there is an expansive list, some of the main needs we defined were: comfort, effectiveness, and availability.

Setting Metrics

Next was to identify general quantitative and qualitative parameters for our patch design based off of the previously suggested customer needs. For our design, we determined patch sizing, materials used, and menthol concentration were the parameters that heavily affected customer satisfaction.

Risk Analysis

With the invention of a new product, one must assess the potential risks involved with use, this can be easily determined through the FDA. Our team found that our device was very safe and only needed to meet few parameters to be dependable.

Design for Manufacturing

Finally, our team needed to determine the overall cost of production and net present value (NPV) of our product. Through various calculations, we found that we could gain ~\$1.9 million in profits in the first year alone.



PRODUCT DEVELOPMENT: MENSTRUAL PAIN PATCH

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PRODUCT DESCRIPTION

The designed product is a single layer drug-in adhesive patch transdermal patch. This patch applies topical pain relief caused by menstruation. This product uses menthol as the primary drug to alleviate the menstrual pain and a skin safe acrylic adhesive for sustained application. It also provides a deep and long-lasting relief for up to 8 hours, while bypassing the GI tract. The patch is discrete as it can be worn under clothes without being seen. It is also versatile as it can be applied to many areas of the body where pain is the strongest.

DESIGN ASPECTS

- **Organic Shape**
Bean-like design allows for a more comfortable fit around the abdomen.
- **Soft Design**
Backing made of soft fabric makes the product feel less foreign during use.
- **Safe & Accessible Materials**
Limited ingredients that are safe for skin. Provided with an easy to peel liner and range of skin colors all at an affordable price.
- **Deeper, Prolonged Relief**
Concentrated menthol in patch format allows for relief in deeper tissues for up to 8 hours after application.

PRODUCT MODELING

Adhesive Testing

This prototype sought to measure the adhesive strength of 3 potential adhesives (silicone-based, isobutylene-based, and acrylic-based) that are currently used in existing transdermal patches. The experiment tested each adhesive's duration of adhesion when subjected to an increasing load. The time to detach and the amount of force to remove each patch were recorded to quantify the adhesive's strength.

Menthol Diffusivity

This prototype was designed to determine the diffusive properties of menthol through skin. An experiment was designed for menthol to diffuse through pig skin, which closely mimics human skin properties, and then measure the amount of menthol that was able to diffuse. Using Fick's First Law the diffusion coefficient of menthol through skin would be able to be found.

Effect of the Adhesive on Diffusion

This prototype was designed to test menthol's ability to diffuse through skin while combined with the best adhesive resulting from the adhesive testing. The goal was to see if the adhesive altered the amount of menthol that was able to diffuse through the same type of pig skin on its own.

