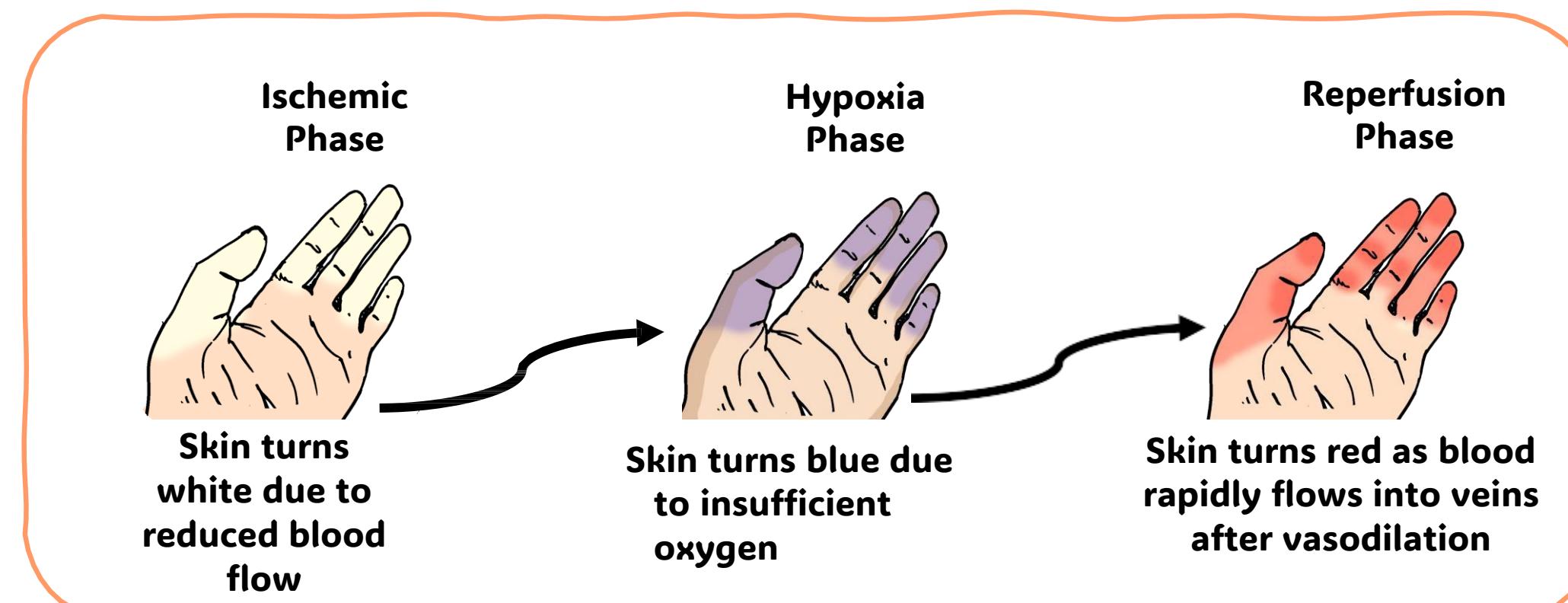


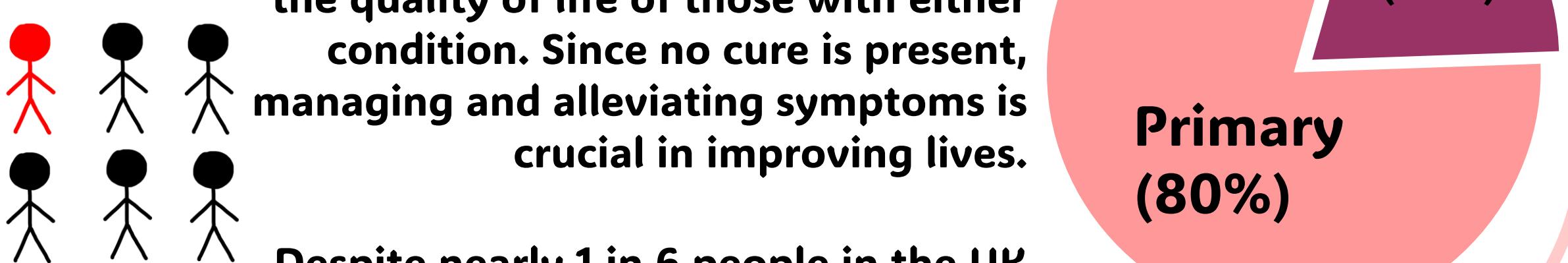
# PiezoCream

## Scleroderma & Raynaud's

- Spasms in small arteries causing reduced blood flow, triggered by cold temperatures or high levels of stress.
- Primary Raynaud's occurs without underlying health conditions, but Secondary Raynaud's is influenced by previous medical conditions such as buildup of collagen due to scleroderma – an autoimmune disease.
- Symptoms include a paleness of the skin, followed by blue colouration due to deoxygenation, and rapid blood reflow. This can be accompanied by a throbbing sensation, effect is most prominent at tips of fingers or toes.

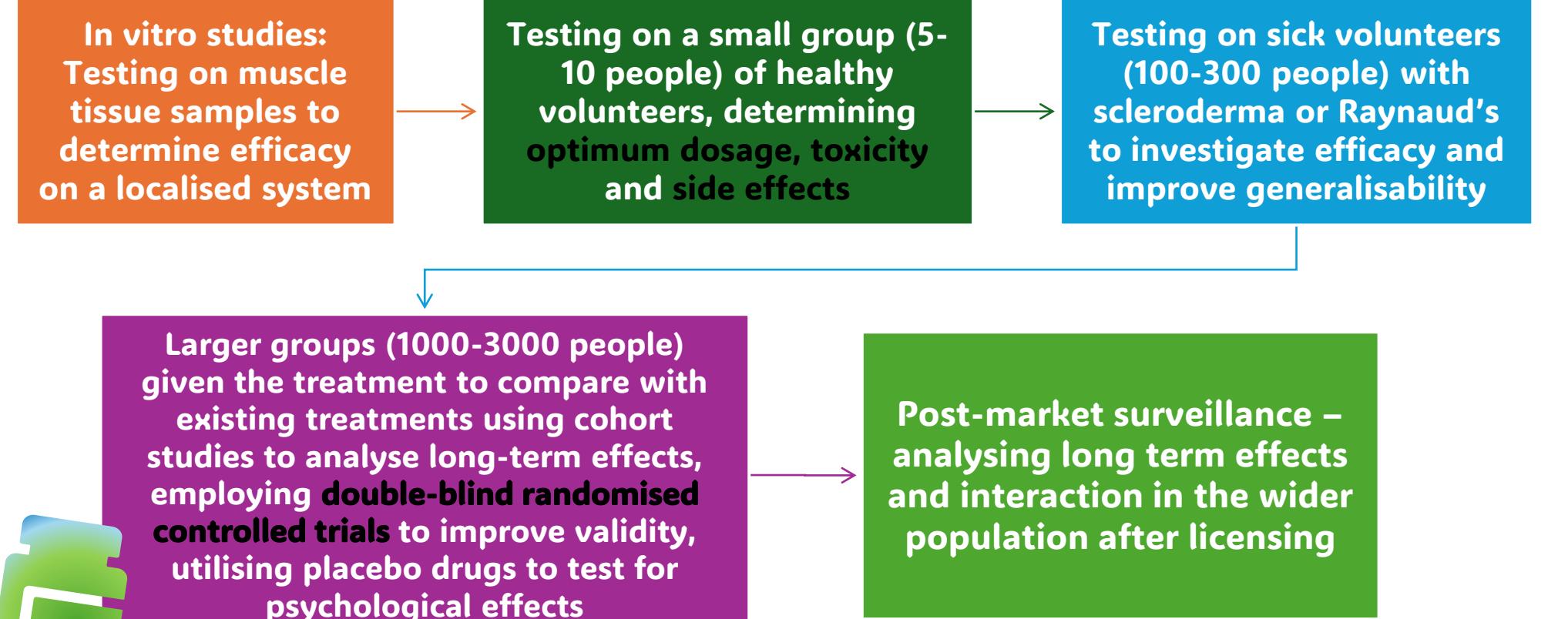


Both conditions have no present cure. In the UK, up to 19000 people have scleroderma and 10 million people have Raynaud's. Both can cause symptoms and emotional distress, leading to a reduction in the quality of life of those with either condition. Since no cure is present, managing and alleviating symptoms is crucial in improving lives.



Despite nearly 1 in 6 people in the UK having Raynaud's, over 24 million people in the UK are unaware of its symptoms.

## Testing and Ethics



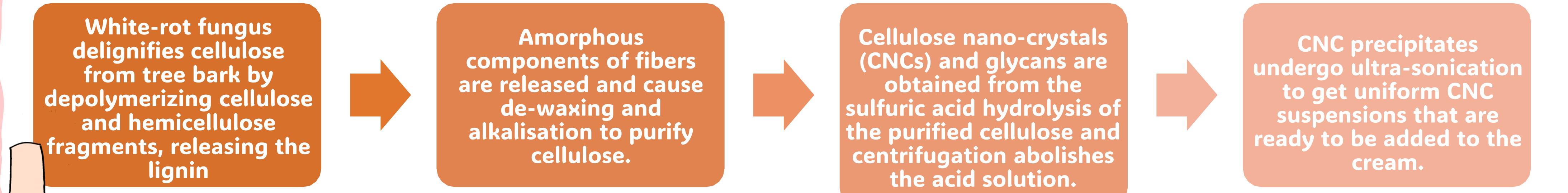
- The level of neuropathic activity and muscle contraction will be measured using an electromyography (EMG) monitor which will print the change in the potential across the nerve when the cream is applied.
- The results will be mapped alongside a series of normal muscle contraction graphs to analyse for abnormalities and modify the thickness of the product based on the variation in the potential observed.
- Potential anti-inflammatory effects will be observed through tissue culture models and clinical endpoints such as scaling, where appropriate anti-inflammatory agents will be added to the cream.

Informed consent will be obtained from all volunteers and the volunteers will have a right to withdraw from the studies.

## Our Product

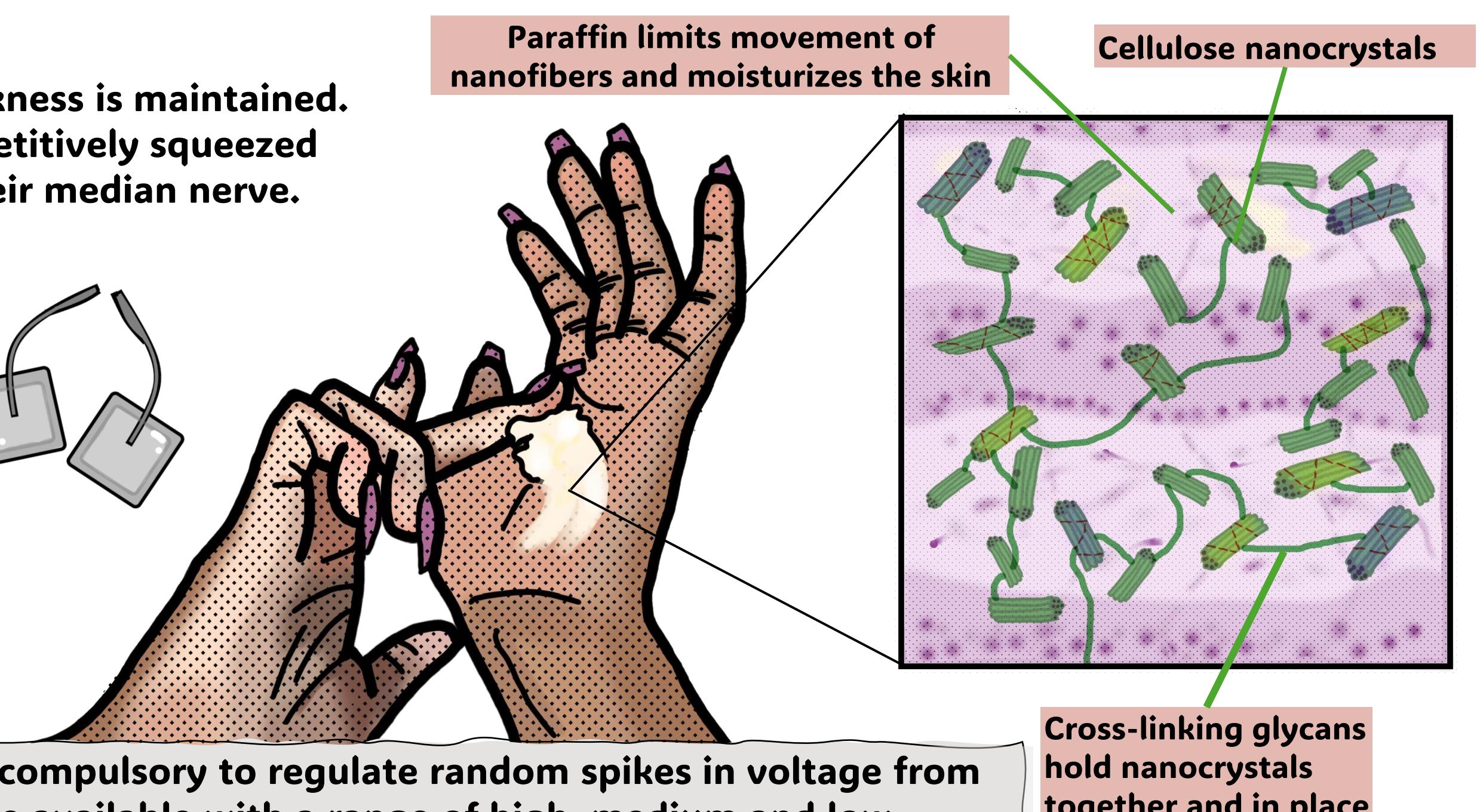
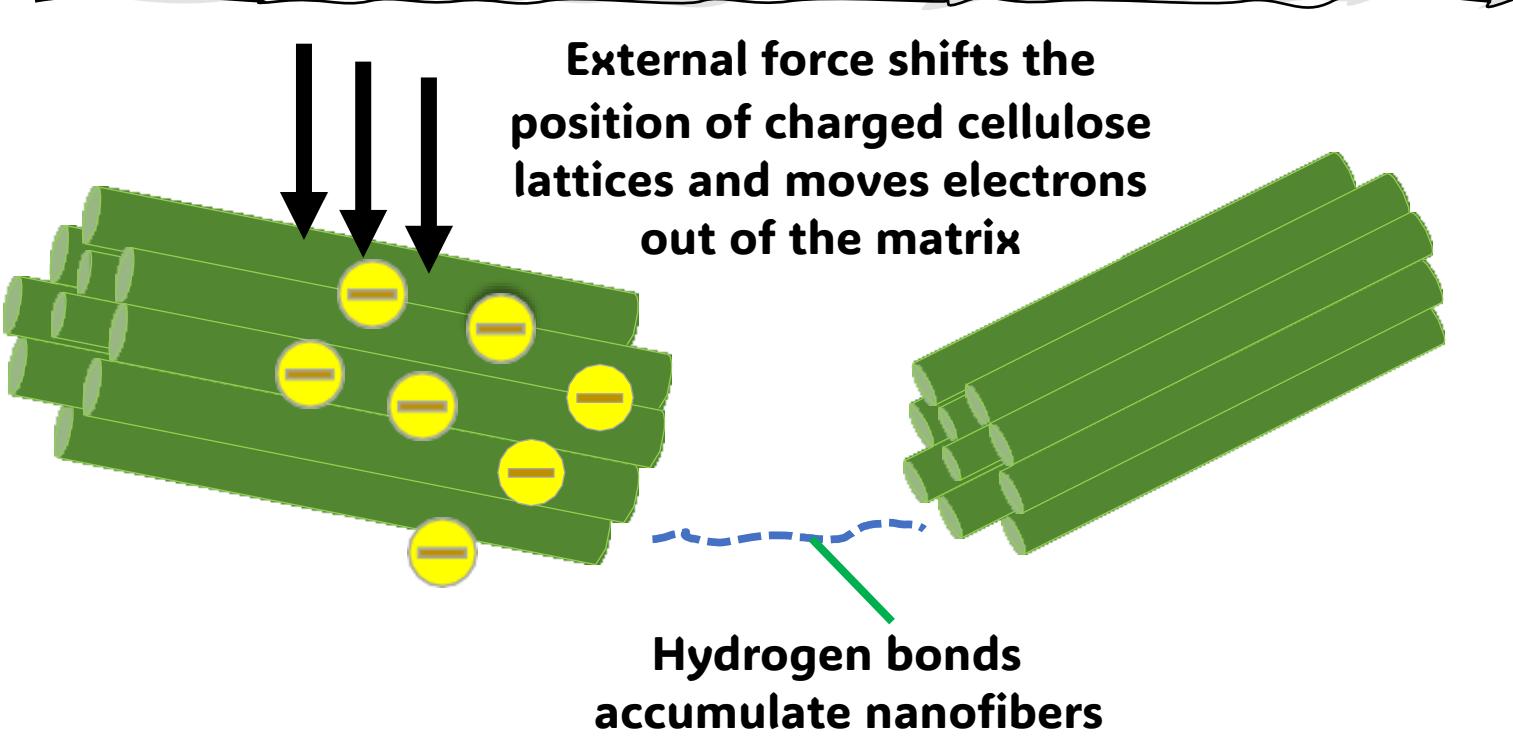
Our product is a wood-based cream that embeds cellulose crystals as the active ingredient to induce potentials through the median nerves for vasodilation. These will be suspended in the base of the cream, a standard composition of thickening agents and emulsifiers.

## How It's Made



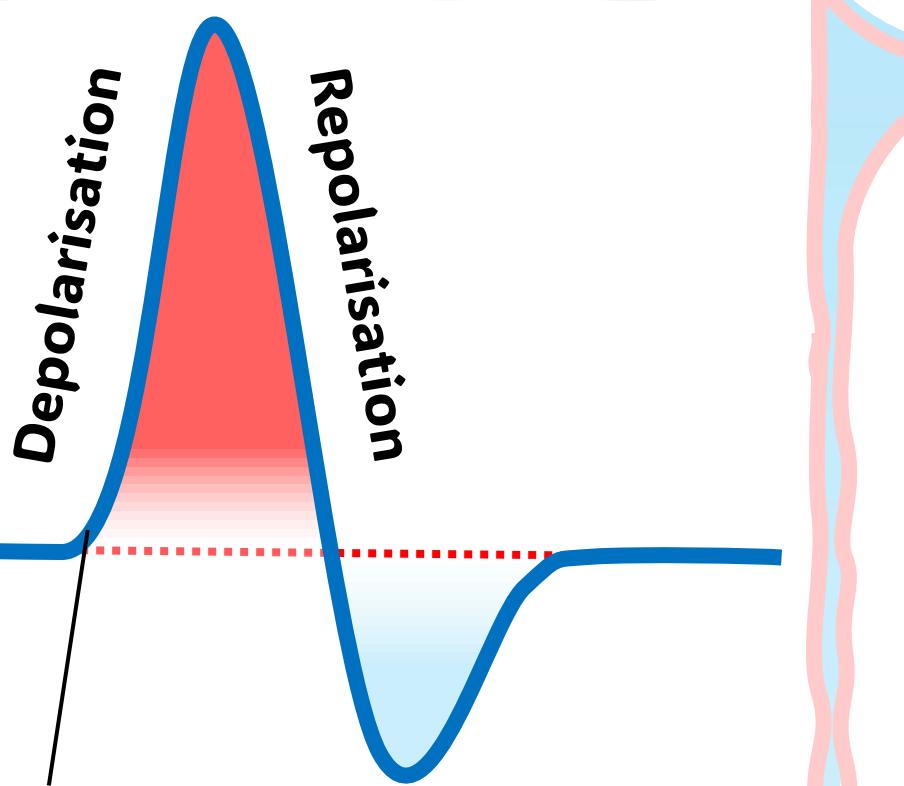
The cream is applied onto the wrist until a sufficient thickness is maintained. Squeeze it with your other hand. The hand should be repetitively squeezed and released to induce an alternating potential across their median nerve.

This product could be coupled with an electrode padding wired with a battery, which would allow for amplified and fine-tuned electromagnetic currents with adjustable parameters like voltage, alternating frequency and dosage precision. It's complementary to the cream and gives the patient an option whether to use an acute practice for instant relief of more serious vasospasms inoperable by weaker electric impulses generated with cellulose alone. Theory suggests that, as the cream cannot allocate charge to the median nerve in sustained proportions, a capacitive electrode may be compulsory to regulate random spikes in voltage from the cellulose that could damage tissue. The cream will be available with a range of high, medium and low cellulose densities that are chosen and issued to patients depending on their symptomatic severities. An ideal combination of variables can be adjusted for optimization with this density factor being accounted for.



## How It Works

The crystalline form of cellulose within wood has an overall negative charge due to many hydroxyl groups present. Crystalline asymmetry is responsible for creating an unequal distribution of charge and cellulose is endowed with electric potential energy. This energy is released when an external pressure is applied onto cellulose, allowing the movement of electrons in cellulose to move out of the fibrils, where a current can be induced to the digital nerves of the hand.



The molecules align to their dipole moments and slide parallel, inducing an electric field. Pulsations in physical pressure on the cream release electrical energy. This increases contact area with the skin, improving consistency around nerves connected to constricted blood vessels. The arrangement also increases their area of contact made with the skin, improving the localised consistency spread around the nerves connected to the constricted blood vessels. It allows for the cream to be stratified with the topical layer being thin since the CNC is in collateral form, reducing the volume of cream needed per use. The electric field stimulates voltage-gated Calcium channels, inhibiting calcium ion entry into smooth muscle cells, causing muscle relaxation and vessel dilation, enhancing blood flow to oxygen and nutrient-deprived areas.

## Advantages and Limitations

- The treatment is made from renewable and biodegradable materials reducing overall cost of treatment
- The treatment can be adjusted according to the level of neuropathy thus making it a flexible option
- Cellulose treatment can provide a long-term solution for patients with Raynaud's which will reduce NHS waiting times
- The cream can be tailored to the gender, skin colour and the age of the patient to embrace a diverse population

- Individual products may not be able to handle spikes in potential due to variations in applied pressure
- Hand applying pressure requires additional covering to prevent electrical transmission to other parts of the body or hand
- Treatment requires continuous applied pressure and pauses which can be tiring
- Electrical stimulation may cause an uncomfortable tingling sensation

## The Team

Baraytuk Aydin – Developed the application of the piezoelectric effect using his interest in Chemistry and Physics and contributed to poster layout

Ethan Chan – Researched on cost analysis, clinical testing and product manufacturing using his interest in Physics and Economics

Adora Edobor – Contributed to social acceptability and used her artistic background to produce clear and detailed graphics

John Prineas – Designed the composition of the product, and identified optimisations

White-rot fungi will be used to delignify the wood, which has a higher efficiency, has a smaller carbon footprint and lower energy costs compared to synthetic processes

Wood is a renewable resource therefore contributes to sustainable development, and has low emission of greenhouse gases, which can be reverted with more plantation

## Feasibility and Optimisations

The cellulose layer acts as an effective moisturiser due to many hydrophilic hydroxyl groups on the fibril, which can reduce symptoms of dry skin

The cellulose layer can improve conductivity through subcutaneous tissue by providing a hydration effect as a moisturiser

## Cost Analysis

The estimated cost of the product, from obtaining raw materials to shipping is £15 per 100g of the product.

Moreover, the estimated cost for the optional electrode would amount to £180 due to expensive electronics and casting required.

The price for the cream is relatively low for a treatment, which reduces NHS outsourcing while providing a non-invasive effective treatment, which improves NHS waiting times and offers a swift procedure for patients with less severe symptoms.

## Bibliography

