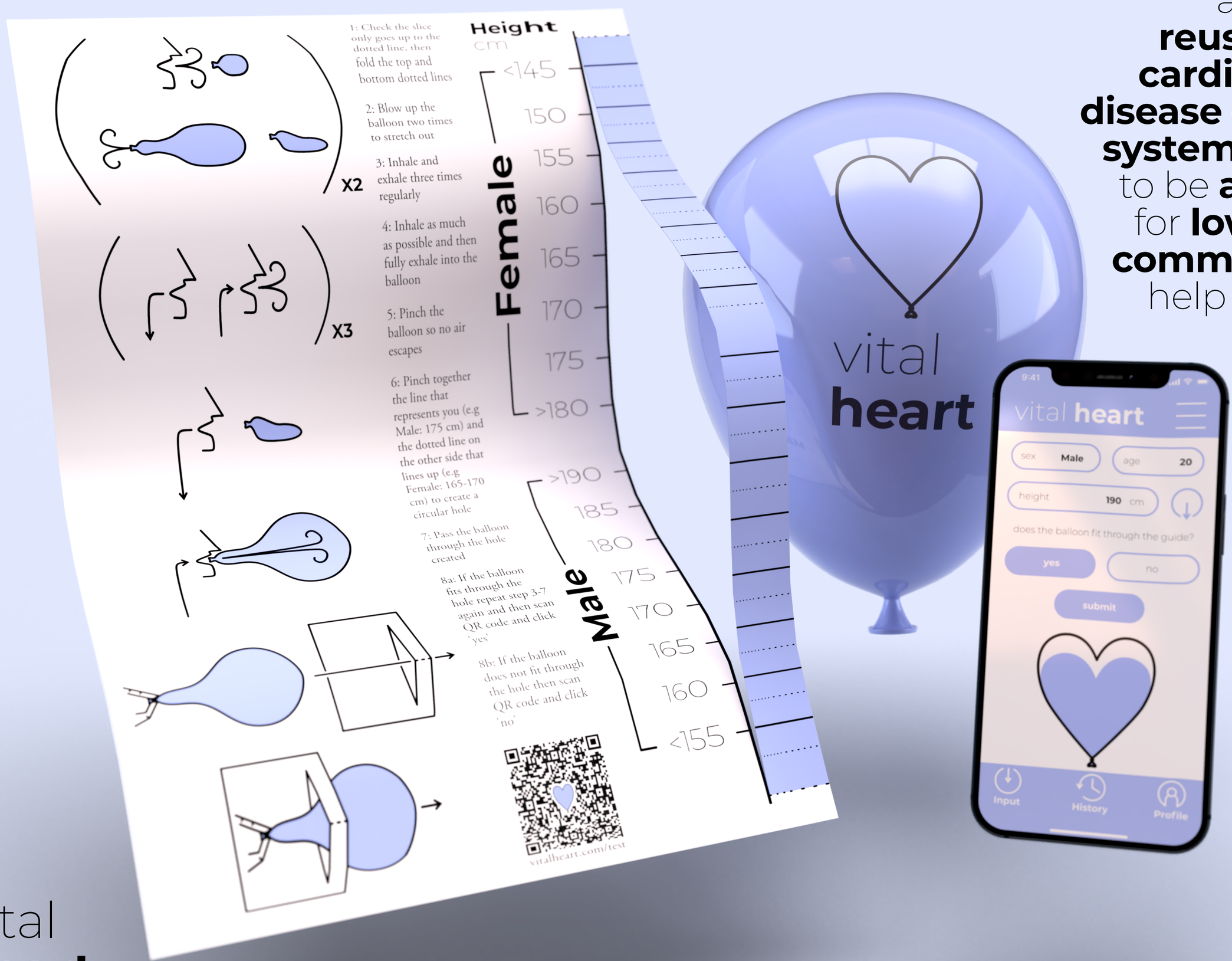
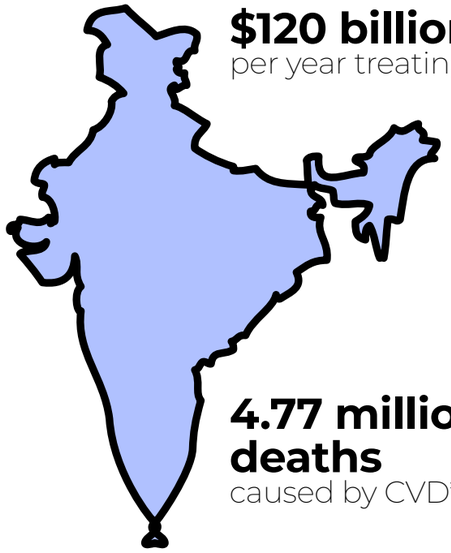
a **low-cost**, **reusable** early **cardiovascular disease detection system** designed to be **accessible** for **low-income communities**, to help **save lives**



vital
heart



$120 billion
per year treating cvd*

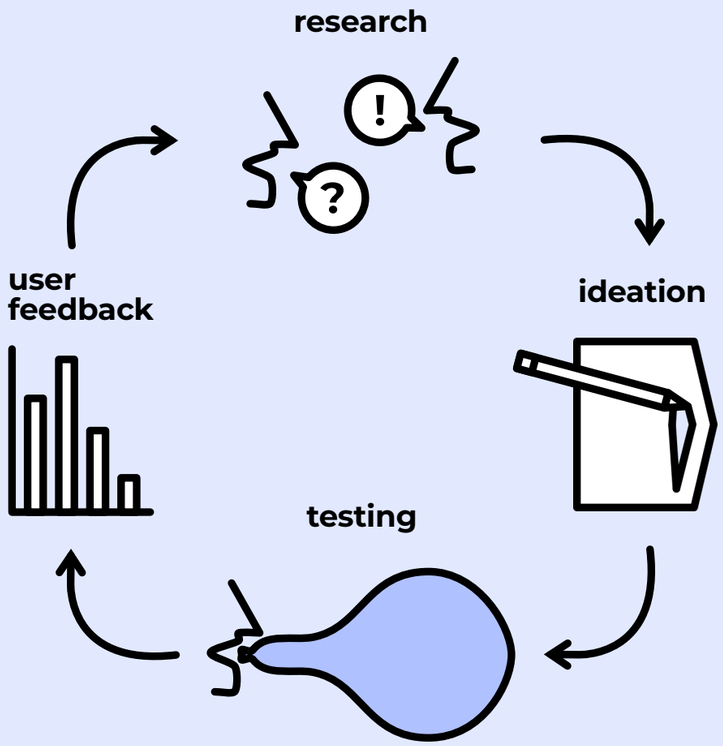
4.77 million deaths
caused by CVD*

problem

At the **start of the century, Cardiovascular diseases** became the **leading cause of mortality in India**. Whilst **medical treatments** and technologies **flourished** in high-income areas, the **lowest-income areas of India** were left behind with a **lack of education**, **inaccessible medical services** and **disproportionate poverty**.

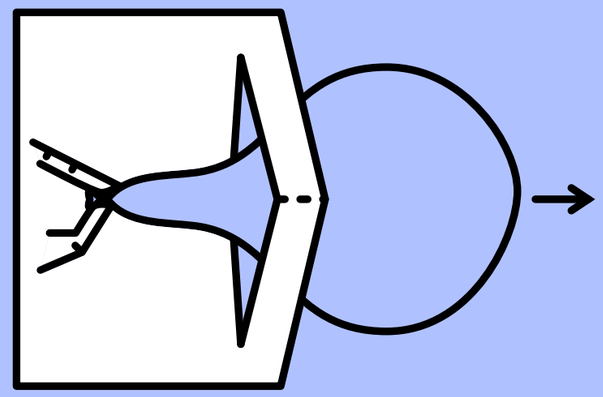
vital
heart

*in **Inda** alone



process

Undertaking a **case study** to answer: **"How are the Lowest-Income Areas of India Affected by Cardiovascular Disease?"** Findings indicated a **lack of medical support**. I then started investigating **how CVD is identified** and was shocked to find the **high cost of inaccessible devices** used **every day**. I then came across how **vital capacity** can be **impaired** by **CVD**. This **knowledge**, **user feedback** and **rigorous testing** helped me **develop** this **testing system**.



proposal

By **creating** a **fully reusable** and **recyclable**, **low-cost early CVD detection system**, **Vital Heart** will aim to **rapidly test thousands** of possible **patients** in **low-income areas**. Patients can take the test and get a **result** within **90 seconds**, **or** just **35 seconds** with **support**.

development of **research**

secondary research

initial findings

target group

- Individuals living in India and low-income states
- Adults who are at high risk of CVD

challenges

- Underdeveloped medical practises in India
- Unreleased data and procedures

current issues

- Expensive tests
- Inaccessible medical attention
- Lack of education
- Low professional-patient ratio

high-cost tests for cvd

Electrocardiogram (ECG), exercise stress tests, X-rays, echocardiogram, blood tests, coronary angiography, radionuclide tests, MRI scans and CT scans

primary research

interviews

charities

To understand the vast capabilities of charities based locally and in India who specialises in health care.

experts

This was critical in understanding how CVD is currently tested and how much time and resources go into each test.

active volunteers

By knowing the levels of education and information charities pass on to volunteers I am able to critically design my project so it is understood by a vast amount of people.

system thinking

root causes

lack of education

Due to the high poverty of low-income areas in India, there is a direct correlation with a poor education system. Even many educated people are not aware of the next steps after being diagnosed with CVD or even recognise the symptoms.

poor diet

A diet consisting of high amounts of Maida (a carbohydrate found in traditional foods) and a low intake of vitamin B-6 is one of India's leading causes of CVD.

medical diagnosis

Most current tests for CVD are based on ECGs, blood tests and doctor interventions. These are all high-cost both in labour, energy supply, research and development.

early intervention

Hundreds of millions of dollars are spent every year treating CVD in India, by initialising early-stage mass testing expensive late stage treatments can be avoided.

initial ideation

creating parameters

case study

My case study helped to identify the main causes of CVD and it's impact on India's people and economy.

testing device

An affordable device that tests for early stages of CVD.

non-electrical testing

A solution usable in low-income areas where electricity is scarce, so the patient can repeat the test independently.

self-testing

A plan to enable people to repeat their self-testing.

reusable & recyclable

A test kit that requires minimal cleaning, zero maintenance and multiple use.

defining limits

research

physical design

The physical design needs to be low-cost, adaptable, reusable, recyclable, widely available and easy to use.

web app design

Create a familiar, easy-to-use web app, which has a high download speed. Any images and animations will primarily be SVG based to reduce file size, and limited graphics will enable quick downloads. Use GPS for local help but with an option for those who do not have a portable device.

accuracy & repeatability

The physical test needs to be repeatable to reduce waste and make testing consistent.

The system will need to meet a standard level of accuracy. However, as a preliminary test, there are health and financial benefits in early intervention & treatments.

proposed solution

features

cvd testing device

Vital Heart will measure vital capacity using a volume of air blown into a balloon. By comparing the volume in the balloon to a standardised score, it can help screen patients with a potential CVD.

inclusive web app

The partnering web app is designed to support the test by tracking and monitoring test readings and will be used to give out a bank of information and support for those who need it.

accessibility for all

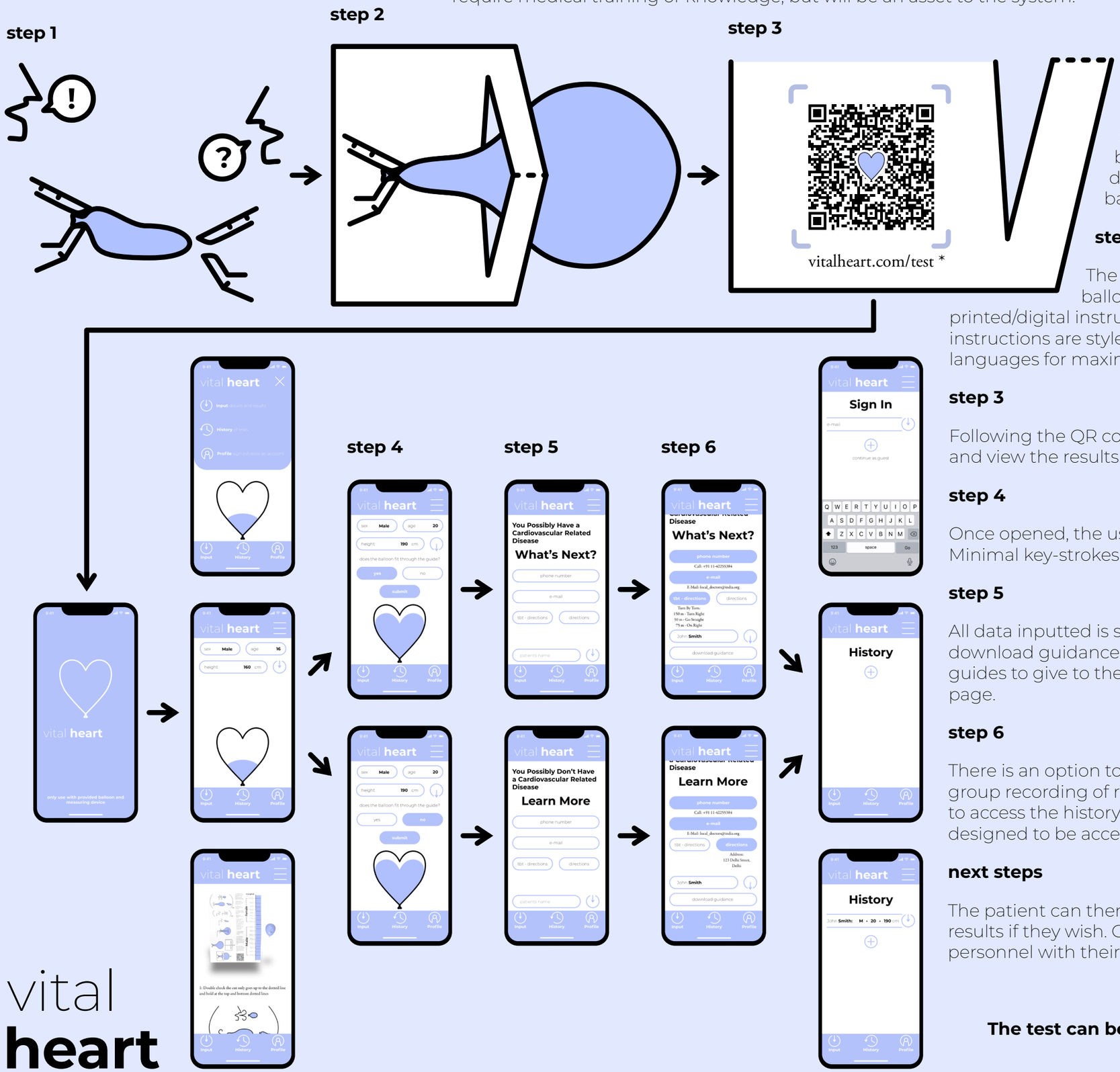
The testing device uses simple diagrams similar to those found in manuals for furniture construction. A single-sided, bicolour print means that the test can be printed at an incredibly low cost on any printer (K only). Using a text-based button system, the web app can be translated into any language and read aloud by accessibility features.

cooperation

Building a connection with a charity would make the test more available and usable by all.

user **journey**

The Vital Heart system aims to deliver an easy, affordable and quick test for the early stages of cardiovascular diseases. The user's journey begins differently depending on their circumstances. For example, In low-income areas such as Kerala, India, where CVD is at an all-time high, charities and local authorities will send volunteers to these areas to test many potential patients. Volunteers will not require medical training or knowledge, but will be an asset to the system.



step 1

Volunteers will communicate with the patient and talk through what is involved and how the test can help them, before handing over the test. In other areas where volunteers are not an option, test packets can be sent to individuals to test by themself and, with the low-cost design, the measuring device can be sent electronically and printed on-site and a balloon can be delivered.

step 2

The patient will then take the physical test involving just the balloon and measuring device with help from the volunteer or the printed/digital instructions. The test is designed to be easy to undertake, and the instructions are styled after worldwide used manuals and formattable in different languages for maximum accessibility.

step 3

Following the QR code or URL printed on the measuring device, the user can enter and view the results.

step 4

Once opened, the user can immediately input the test results onto the app. Minimal key-strokes and inputting steps support limited or poor wi-fi connection.

step 5

All data inputted is saved automatically. Contact choices with the option to download guidance on how to improve cardiovascular health. A list of leaflets and guides to give to the patients, accessible by the volunteers is also linked on this page.

step 6

There is an option to link clients to their result for more effortless follow-up and group recording of results when required. signing in will be available on any device to access the history section. However, it is not crucial to sign in as Vital Heart is designed to be accessible to everyone.

next steps

The patient can then repeat the test multiple times at their leisure and input results if they wish. Group data entries can be collated & accessed by authorised personnel with their login.

The test can be taken within 35 seconds with a volunteer or under 90 seconds without.

vital
heart

* xd.adobe.com/view/66d561d5-c0fb-4f20-9630-9a3c54aba3c0-3386/

global **viability** & design **innovation**

viability

global uses

design adaptability

The instructional diagrams are designed with a simple two-tone scheme, for low cost printing and a consistent border which stands out and is readable from arms length. The web app utilises all the information required to take the test in a format that can be translated into different languages and read aloud for those who need it.

medical viability

Vital Heart works by measuring the vital capacity of a patient. The vital capacity is the largest volume of air that can be exhaled after the deepest possible breath. By measuring vital capacity, this system can be used to detect other illnesses caused by chronic obstructive pulmonary diseases (COPD), restrictive airway diseases (RAD) and structural restrictive airway diseases (SRAD), not just CVD. This system aims to identify the early stages of CVD. It is designed for many people who would not previously seek medical attention or those who consider themselves as 'healthy and fit'.

viability in the lowest-income areas of India

system in practice

Vital Heart would partner with an Indian based charity. This would enable volunteers to travel around the lowest income areas of India and areas that have the highest rates of CVD. With volunteers' help, each test can be completed in just 35 seconds to reach the maximum amount of potential patients who would not usually have access to an internet device or an address for delivering these tests. Once the patients have the results, they can receive guidance directly from the volunteer and the following steps required to recover.

vital
heart

innovations

design

reaching all the target groups

The design is crucial for this system's success. Vital Heart has been designed to follow strict guidelines for brand consistency and accessibility for low literacy levels, including the instructional diagrams, web app design and animations.

By creating SVG animations, the load speed of the web app is dramatically quicker than with standard MP4 formats. This is even more apparent with a poor cellular service. The non-SVG animations in the web app are optional and are not needed to undertake the test but can be used as an aid.

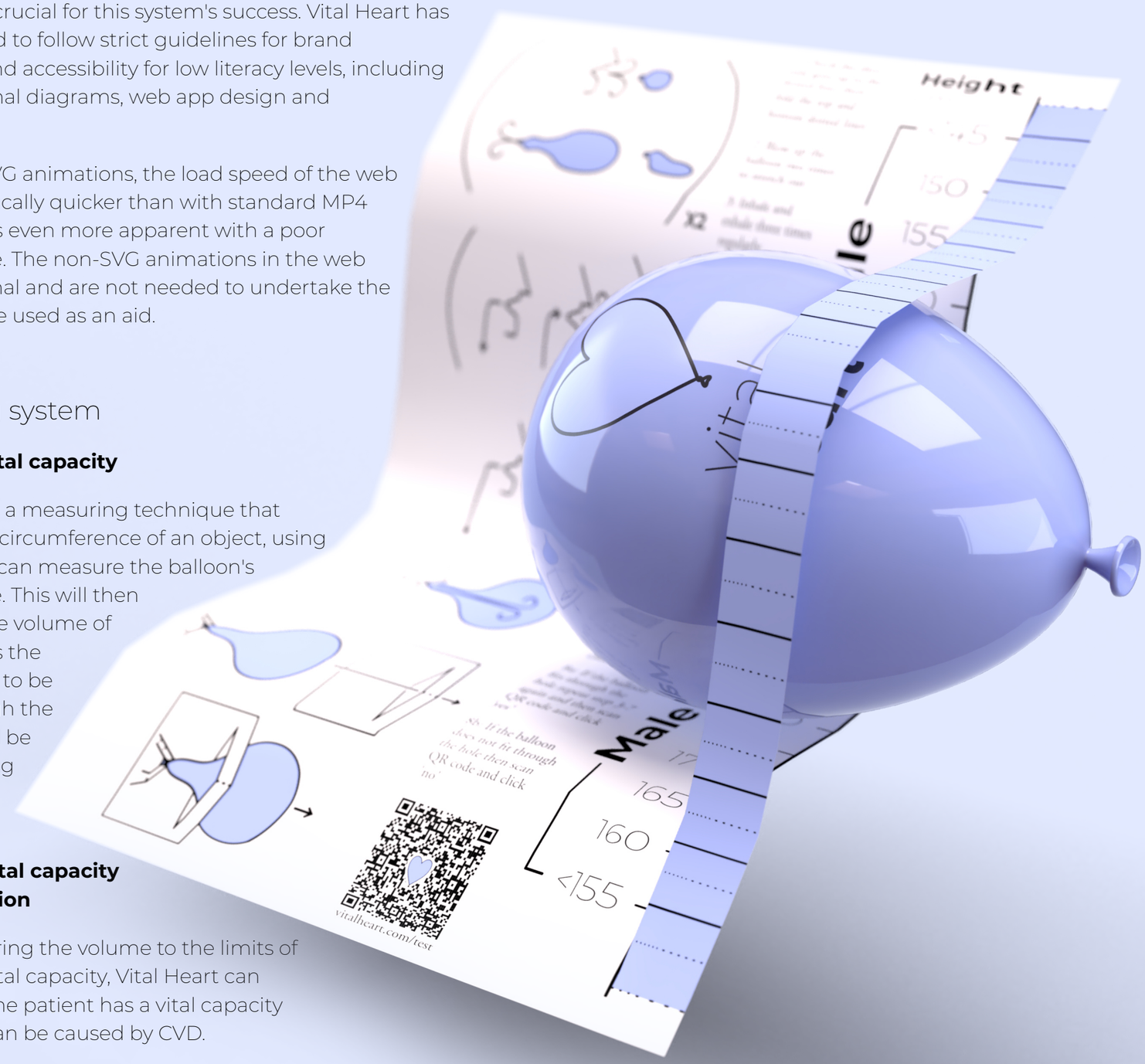
measuring system

measuring vital capacity

By developing a measuring technique that measures the circumference of an object, using π, the cut out can measure the balloon's circumference. This will then correlate to the volume of the balloon. As the balloon needs to be passed through the hole, there will be no error finding the largest diameter.

converting vital capacity to cvd detection

When comparing the volume to the limits of the average vital capacity, Vital Heart can determine if the patient has a vital capacity issue, which can be caused by CVD.



social & **environmental** impact

social impact

individuals

awareness

Whether the patient gets a positive or negative result, Vital Heart can still deliver guidance and help improve an individual's fitness, health and awareness of cardiovascular diseases.

health

CVD is responsible for over 25% of all deaths globally; tackling this head-on with early-stage testing can cut these deaths dramatically. Once individuals are aware they can take the necessary steps to be treated in order to live a helathlier life; as early stage CVD is a reversible health issue.

life expectancy

Looking at the target group of India, life expectancy is currently 69.5 years. However, with regular testing and medical attention, the life expectancy can be increased by 3+ years to closely reflect the world's average life expectancy, by treating individuals earlier.

communities, countries and governments

education

Vital Heart is designed to be a community-wide testing scheme that can be delivered across countries to the lowest-income areas with typically low literacy levels. The easy to use vital heart test is widely accessible to all and will educate thousands about their own cardiovascular health. This improves the communities dramatically and shows how life-changing this knowledge can be.

money saved

Treating patients at an early stage of CVD is cheaper and less time consuming than traditional treatment costing an average of $120 billion annually treating CVD in India alone. This money saved can further the accessibility of Vital Heart and education in low-income neighbourhoods.

poverty

By identifying those affected by CVD and getting them treated in their early stages, communities of low-income areas can start relying on older generations to work longer and help bring these areas out of poverty.

vital
heart

environmental impact - after the test

reusability

the testing system

Vital Heart is made up of 3 parts: one balloon, one measuring device (A4 print) and a web app. The balloon can be reused multiple times by the same patient. It is used only to measure volume and is not affected when the balloon's elasticity is compromised after many uses. The balloon can be cleaned between uses if necessary, but is only recommended to be used by the same patient to minimise the spread of any respiratory diseases. The measuring deivce can be reused on an unlimited amount of patients, however as it is paper it has the possibility of ripping which would render the measurements inaccurate. The final piece of Vital Heart is the web app that can also be used unlimited times and can save test results for individuals and groups.

recycling

the balloon

When the balloon is physically broken either by being punched or ripped, a new balloon will be required to complete a test. The balloons can be made out of 100% latex which is biodegradable; however, ≈1% of people are allergic to latex, alternatives can still be recyclable, however more expensive.

the measuring device

The measuring device is formated to a standard A4 piece of paper, which means that it can be printed on recycled paper, and once it becomes unusable, it can be recycled again. The measuring device can be printed in any location meaning there can be a cut down on the carbon footprint of Vital Heart.