intracardia

Meet the team:
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Arrhythmia and its effects

Arrhythmia is a group of diseases referring to irregularities within the rhythm of one's heartbeat. There are five main types of arrhythmia:

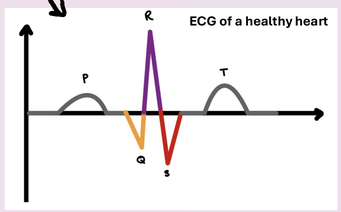
- Atrial fibrillation- where the heart beats faster than normal; it is the most common type of arrhythmia
- Supraventricular tachycardia- episodes of abnormally fast heart rates at rest
- Bradycardia- where the heart beats slower than normal
- Heart block – the heart beats slower or its electrical signal is interrupted, and it can cause people to collapse
- Ventricular fibrillation – a rare, rapid and disorganised rhythm of heartbeats that leads to the loss of consciousness and sudden death if not treated immediately

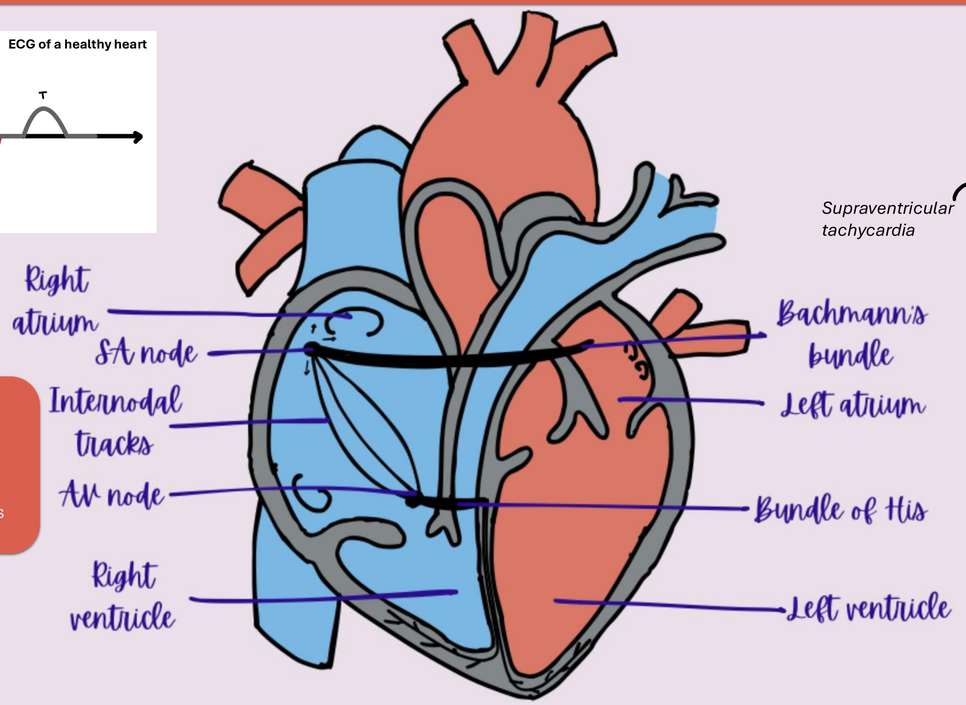
Severity

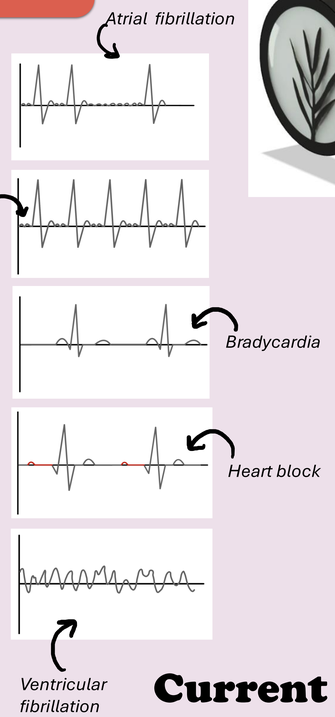
Arrhythmia is estimated to affect 2 million people in the UK alone, most primarily through atrial fibrillation At least 270,000 people in the UK remain undiagnosed and unaware It affects more than 33 million people globally. Sudden cardiac death from arrhythmia kills 100,000 people in the UK every year, of which some of these deaths could have been avoided if the arrhythmias were diagnosed earlier. Atrial fibrillation increases the risk of stroke by 5 times more than for someone whose heart rhythm is normal.

Context: Heart's electrical conduction

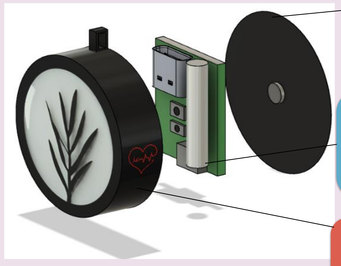
The heart's electrical conduction starts at the sinoatrial (SA) node (producing the P-wave), which generates electrical impulses. These impulses spread through the atria, causing them to contract and push blood into the ventricles. The impulses then reach the atrioventricular (AV) node (producing the Q, R and S waves), where they are briefly delayed. From the AV node, the impulses travel through the bundle of His and down the Purkinje fibers, leading to coordinated contraction of the ventricles. This systematic conduction ensures efficient pumping of blood throughout the body.







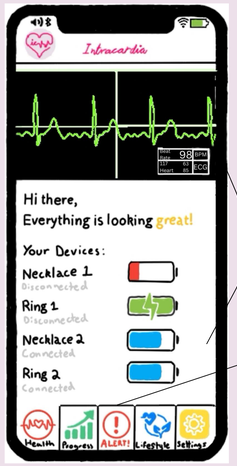
Product diagram



Back casing- this contains the electrode which is in constant contact with the skin to take readings.

PCB board with Bluetooth and battery- an included lithium-ion rechargeable battery alongside the main electrical component which will be communicating the data between the device and installed app.

Front shell and casing- mainly protecting the internal components and this is a customisable component with the ability to choose from at least 8 designs for both the rings and necklaces.



The app compares the ECG of the user with arrhythmic and normal ECGs to confirm whether the user's heart is healthy.

The app also displays battery lives of the devices, the user's progress, lifestyle tips and settings (to manage accounts).

If issues are found with the ECG, the app alerts the user and if needed their medical supervisor.

Our Solution

These pieces of jewellery act as two leads to measure the electrical conductivity of the heart.

This data is then transferred and organised into an electrocardiogram (ECG) on the device where the corresponding app is downloaded.

During treatment: The ECG is compared to previous records of the patient's heart to detect progress with the treatment and discuss whether this is the best method.

Post- treatment: The ECG is compared to others, where some show an issue in the heart and others display a healthy heart, to confirm the treatment has worked and to monitor the patient's heart ensuring the disease does not return.

If any issue is discovered, the app alerts both the patient and their respective doctor. The patient's medical records can be updated with the incoming data.

Meeting societal standards

Feasibility: This initiative would be funded through the NHS Long Term Plan as it aids in the delivering of care to one of the world's major health problems- arrhythmia. The opportunity cost of the implementation of the project will be largely offset by not only the reduction in the cases of strokes and heart attacks, but also the savings made by the NHS in the long term from fewer scheduled hospital appointments. Ambulatory ECG machines have been in existence since the late 1940s and have had a long history of usage in healthcare settings. We have improved this technology, making the product quite feasible to manufacture.

Acceptability: Familiarity with the technology will help to alleviate any concerns about the product. Multiple leads offers a significant advantage over existing single-lead machines as they enhance its diagnostic capabilities, making it more attractive to healthcare professionals. Our design is aesthetically pleasing, and this will help to differentiate it in the market and increase its popularity amongst competitors.

Affordability: Each set of systems is almost 10 times more affordable than getting one electrocardiogram scan done privately in the UK. Each pack including 2 rings and 2 necklaces (£14.73 per unit) will cost around £60.00 and we can expect the price to reduce further through bulk buying.

Availability: The components used are readily available, so there would be no issues regarding the supply of our product. After receiving feedback from local hospitals that use it, we would improve the product and provide this to other low-income countries and countries with low doctor-to-patient ratios. This would help to satisfy the high global demand for a product of such capabilities.

Intracardia and testing

IEC 60601 is a series of technical standards for the safety and performance of medical electrical equipment - compliance with these is necessary for our device to enter the UK market. The specific IEC 60601-2-47 standard for ambulatory electrocardiograph systems must also be met. Some tests which need to be carried out to meet these standards are vibration and shock testing for durability, as well as user interface testing.

We will then use a case-control study to test the effectiveness and accuracy of our product in monitoring arrhythmia as follows:

- Identify a sample of at least 5000 adults, half of whom will be diagnosed with some form of arrhythmia and the others being healthy individuals.
- Give each person our product and ask them to wear it consistently for one week. During this time, we will collect the data and store it in a larger database.
- The data of the control group can be compared against the people with arrhythmia to ensure the product is able to effectively record normal and abnormal rhythms.
- Implement the initiative within a few hospitals and GP surgeries, allowing doctors to provide further feedback on how well our product monitors the disease

Current solutions vs Intracardia

Monitoring device	Description	Advantages	Disadvantages
Holter monitor 	Consists of leads attached to the skin and plugged into a recording device which is worn around the neck. Typically used for 24 or 48 hours and records every heartbeat during that time.	- Can be used whilst patients are carrying out daily activities - Gives the most detailed information out of all pre-existing ambulatory ECG monitors	- Uncomfortable – many complain about skin irritation due to the adhesion - No real-time analysis - Can only be accessed through a physician - Cannot be worn on a day-to-day basis
Patch monitor 	Small adhesive patches continuously monitor the electrical conductivity . It stores a person's heartbeat when worn and can transmit an ECG wirelessly if cardiac arrhythmia occurs.	- Unobtrusive - Water-resistant - Can be worn for up to 2 weeks	- Those with only one lead are less accurate - Can't be worn on a more long-term basis
Intracardia 	A pair of devices replicating jewelry but performing the functions of a modern ECG machine by detecting and transmitting the electrical signals of the heart to an app.	- Can be used while patients are carrying out daily activities - Real-time analysis and alerts - Can be worn for long periods of time and are reusable - More affordable to the public - More discrete method	- Requires constant wearing for constant monitoring - Requires external device(s), for example something to download the app on