# CardioBound

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2026

**Key Facts on Cardiovascular Disease and Related Events in the U.S. (2024)**

| Statistic | Value |
|---|---|
| Total CVD deaths per day | 2,552 |
| Deaths from heart disease per day (including heart attacks) | 1,905 |
| Average time between heart attacks | Every 40 seconds |
| New heart attacks each year | Approximately 605,000 |
| Recurrent heart attacks each year | Approximately 200,000 |
| Silent heart attacks | Estimated 170,000 |
| Average age at first heart attack (males) | 65.6 years |
| Average age at first heart attack (females) | 72.0 years |

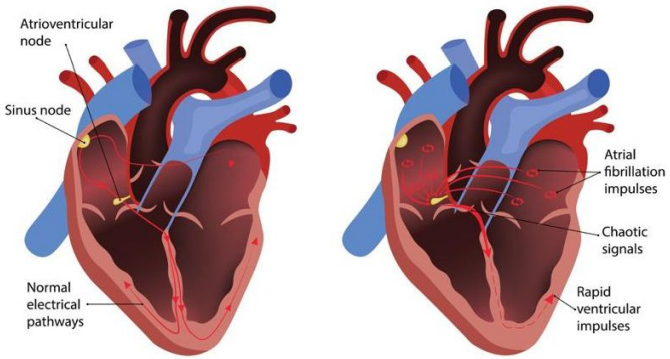
GENERAL CARDIOLOGY

# Heart Disease, Stroke Account for More Than 1 in 4 Deaths in US

## Stroke's Resurgence as a Leading Cause of Death in the United States

Adam de Havenon [1], Kevin N Sheth [1]

# Heart arrhythmia




NHLBI IN THE PRESS

## Atrial fibrillation estimated to affect about 1 in 22 Americans

September 12, 2024

## Deaths related to irregular heart rhythm may be rising, especially among younger people

By Thor Christensen, American Heart Association News

**Challenges in the Classification of Cardiac Arrhythmias and Ischemia Using End-to-End Deep Learning and the Electrocardiogram: A Systematic Review**

Edgard Oporto [1,*], David Mauricio [1], Nelson Maculan [2], Giuliana Uribe [3]

Editor: Yiqing Yang

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PMCID: PMC12785992 PMID: 41515656

## New research finds 62% of AFib patients were unaware of the condition before diagnosis

The American Heart Association urges people to learn the signs of atrial fibrillation and take steps to protect their health

# 01 | Problem

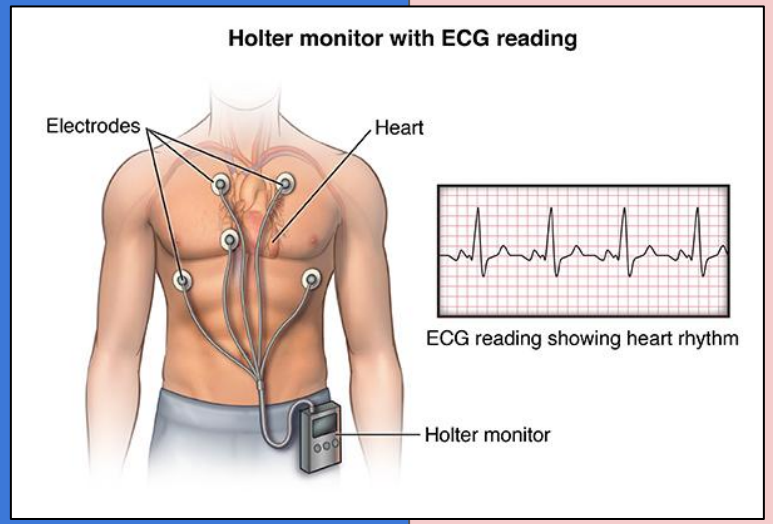
# 10.55M PEOPLE ARE AFFECTED BY A CARDIAC ARRHYTHMIA EVERY YEAR IN THE UNITED STATES.

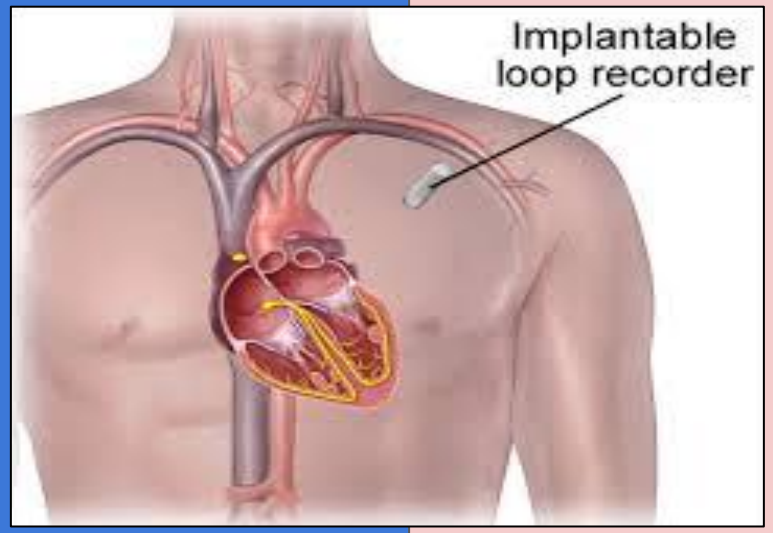
- Over 2/5 of cardiac arrhythmia cases remain undetected during routine screening exams.
- Monitoring costs thousands per patient and requires repeated clinical visits.

# TRADITIONAL ARRHYTHMIA MONITORING IS

Expensive. Invasive. Inconvenient.

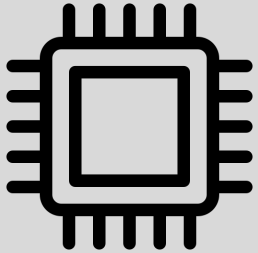
*and* costs over **$10,000 per patient** for implantable monitoring or **$2,000+** for short-term Holter testing while millions remain undiagnosed.



# CARDIOBOUND

addresses the limitations of current arrhythmia diagnosis and monitoring through a comprehensive 4-phase solution

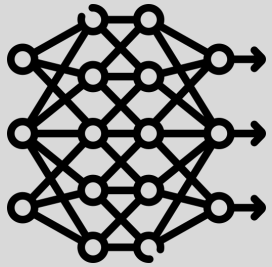


## Microprocessor Suite

Raspberry Pi & Jetson Nano enables real-time, on-device data transmission

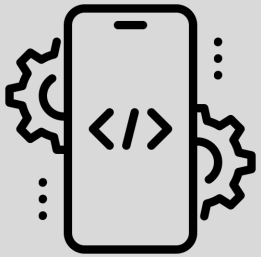
## Signal Processing

Bandpass filtering, R-peak detection, and HRV analysis isolate essential ECG signal frequencies



## CNN-LSTM & XGBoost

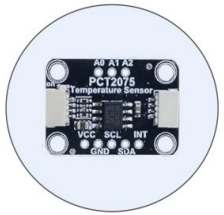
Deep learning algorithms detect arrhythmias and conduct risk stratification



## Mobile Application

Provides targeted cardiac health insights for patients and clinicians

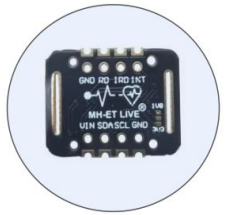
## Technical Overview




PPG

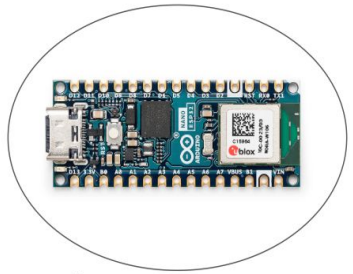
ECG


IMU




Temperature

Jetson Orin Nano



Arduino Nano ESP32

## XGBoost: Risk Stratification

Admission Date: 2016-08-08 Discharge Date: 2016-08-15
HISTORY OF PRESENT ILLNESS:
The patient is a 37-year-old lady with type 1 diabetes mellitus, who is four months post cadaveric kidney transplantation and now has good graft function. She presents for cadaveric pancreas transplantation. Her diabetes mellitus has been complicated by retinopathy and nephropathy as well as peripheral neuropathy. She takes 14 units of NPH insulin twice a day.
HOSPITAL COURSE:
She underwent cadaveric pancreas transplantation without complication. She received induction therapy with thymoglobulin intraoperative and postoperatively for five days. She was kept on a similar immunosuppressive regimen as with her kidney transplant. She had excellent pancreas graft function immediately. Her renal function also remained stable in the perioperative period. She was quickly placed on a diet and advanced to regular diet. She was discharged home in stable condition on postoperative day six.

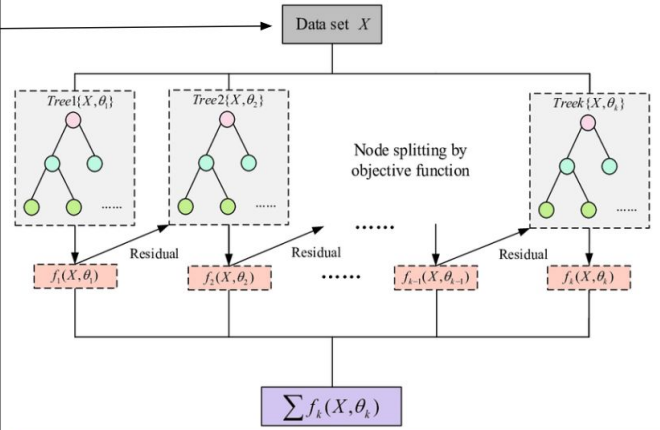
Clinical Text Datasets:

- MIMIC-IV-Ext Cardiac Disease
- MIMIC-IV-ECG

| | |
|---|---|
| Learning Rate: **0.03** | Gamma: **0.4** |
| Max Depth: **5** | Subsample: **0.75** |
| Estimators: **850** | |

**Source: Research Gate**

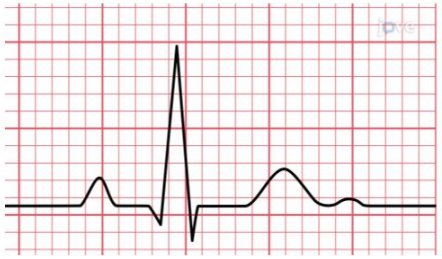
XGBoost Model - cardiovascular risk forecasting




**Low:** p < 5% | **Moderate:** 5% ≤ p < 15% | **High** p ≥ 15%

**Source: Medium**

## Hybrid CNN-LSTM: Detection

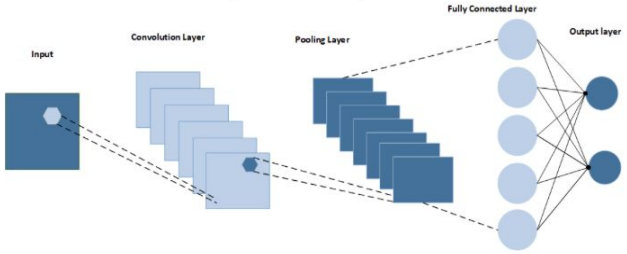


PhysioNet Databases:

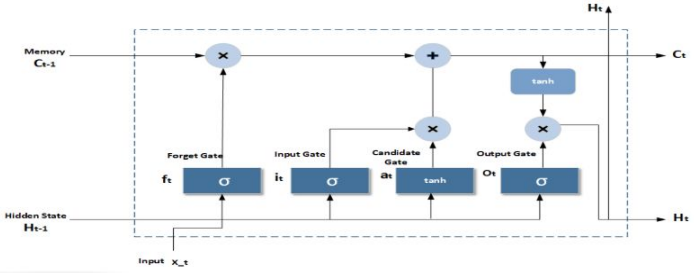
- MIT-BIH Arrhythmia Database
- MIT-BIH Fibrillation Database
- Long-Term AF Database

Trained on **500,000+** annotated cardiac cycles of datapoints

Convolutional NN - spatiotemporal feature extraction




Long-Short Term NN - temporal dependencies



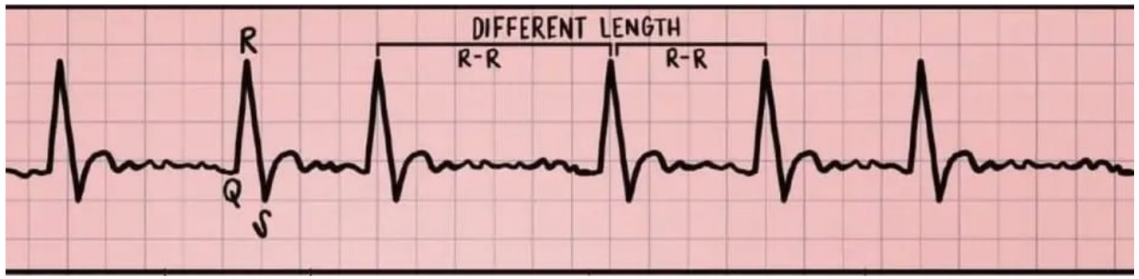

**Source: Medium**

## Solution: CardioBound

1. Multi-Fusion Sensor Array
   with compact PCB integration
2. EdgeAI Algorithms
   using SOTA deep learning architectures
3. Cloud Integration
   for real-time data visualizations

# 05 | Solution

## Mathematical Validation



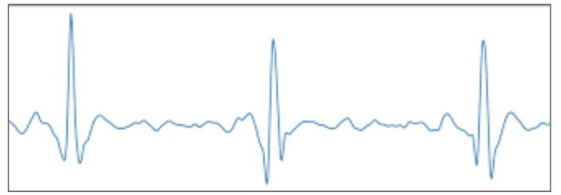

Computing HRV

$$\text{SDNN} = \sqrt{\frac{\sum_{i=1}^{n}(RR_i - \overline{RR})^2}{n}}$$

**Normal:** >50 ms | **Arrhythmia:** <30 ms

**Source: Empirical Health**

## Signal Processing Pipeline



Raw ECG Signal

**RMSSD - Heart Rate Variability**

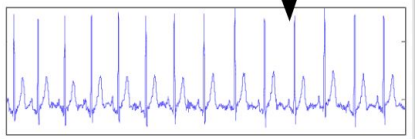
$$RMSSD = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N-1}(RR_{i+1} - RR_i)^2}$$

**Signal-to-Noise Ratio**

$$SNR = 10\log_{10}\left(\frac{P_{\text{signal}}}{P_{\text{noise}}}\right)$$

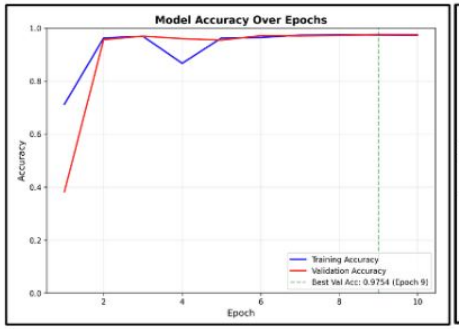
Bandpass Filtering → R-peak detection → HRV extraction → Artifact Removal

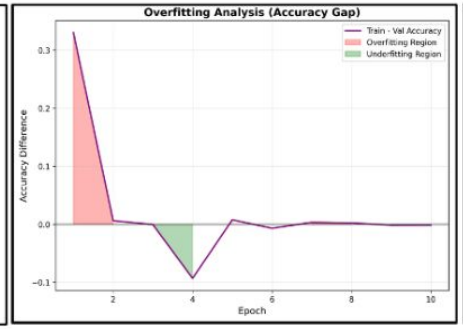
Bandpass Filter ECG Frequency: **0.50 - 40 Hz**
PPG Frequency: **1.00 - 1.67 Hz**
IMU Frequency: **0.50 - 5.00 Hz**

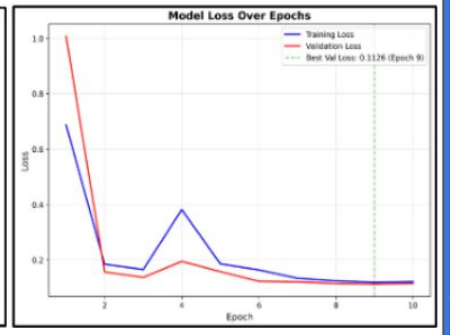


Clean ECG Signal

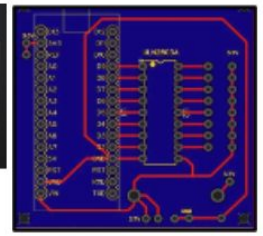
## Data + Product Visualization




Our hybrid CNN-LSTM algorithm achieves a high accuracy (~97.5%) with minimal overfitting, **outperforming current alternatives.**

Custom PCB layout (designed on EasyEDA) housing all electronics on the Arduino Nano ESP32.

## 3. Mobile Backend Application


At-home screening capabilities

Real-time cardiac health insights | Predictive risk alerts

**Estimated Retail Cost: $199**
66% less than industry standard

## 2. AI-Powered Analysis

**1 Signal Processing**
- Bandpass filtering
- R-peak detection
- HRV extraction

→

**2 Hybrid CNN-LSTM Network**
Spatiotemporal ECG pattern recognition

→

**3 Risk Stratification**
Logistic regression for disease forecasting

**Powered by Raspberry Pi + Jetson Nano**

# 06 | Solution

## Competition Analysis

### 1 iRhythm Technologies

~$500-1000+ USD per use | Short-term monitoring


### 2 Medtronic (LINQ)

~$10,000 - $15,000+ USD | Requires surgery


### 3 Phillips (MCT Patch)

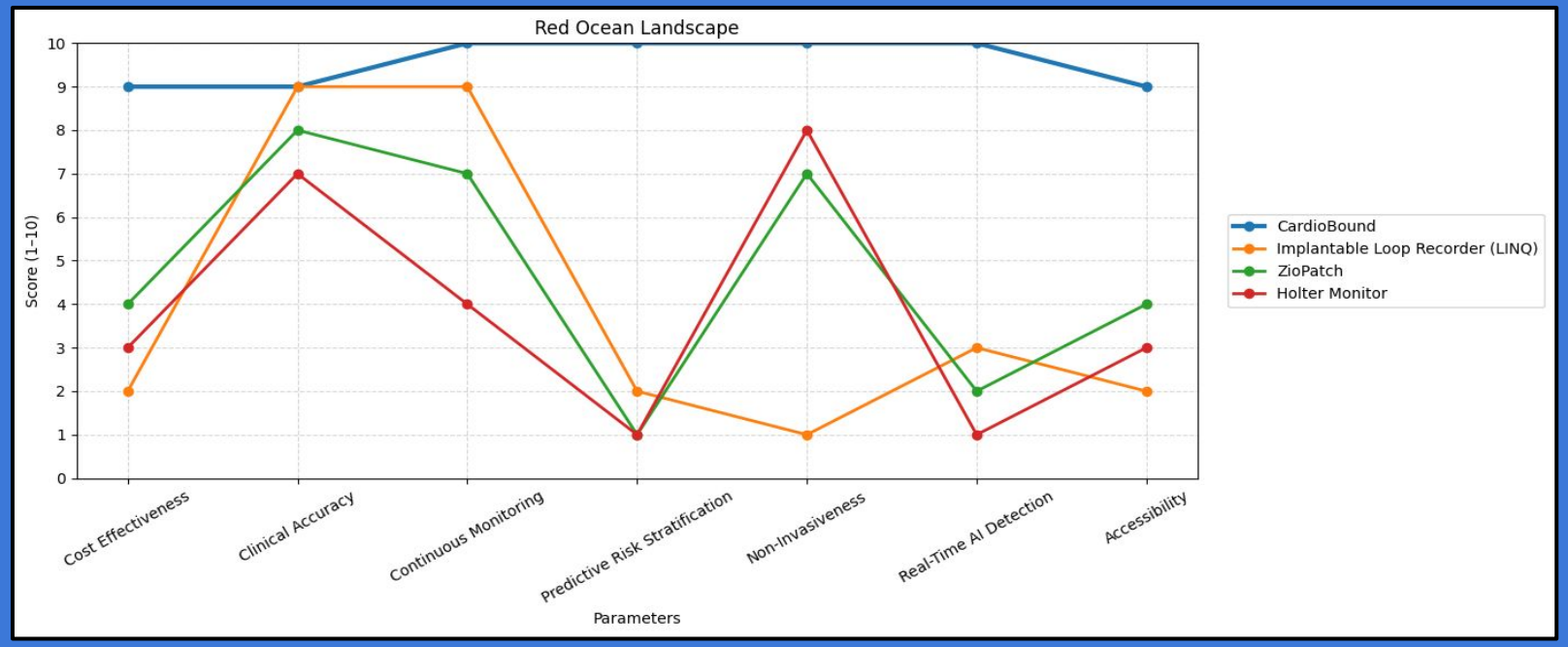
~$3,000 - $5,000 | Bulky | Limited wear

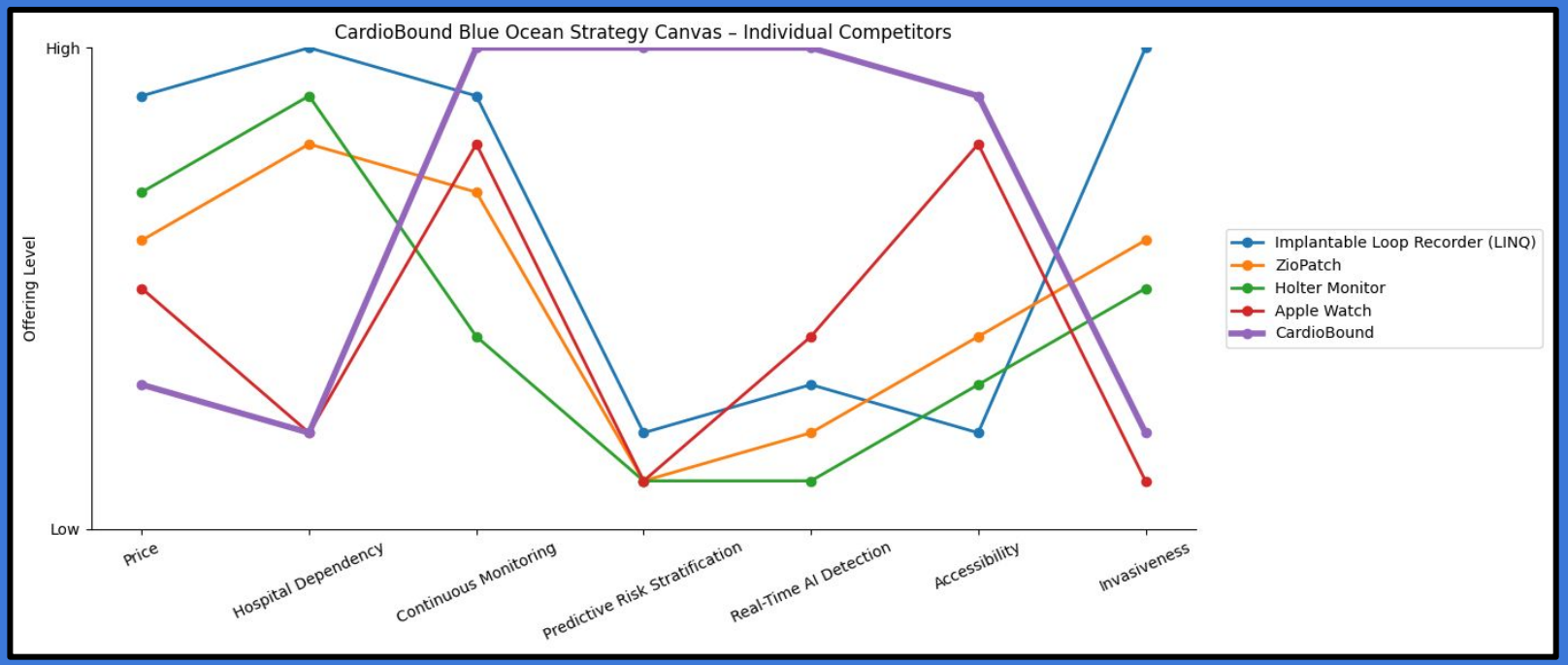
# 07 | Competitive Landscape

# UNIQUE VALUE

| | CardioBound | Holter Monitor | Implantable Recorder |
|---|---|---|---|
| Real-Time AI Detection | ✓ | ✕ | ✕ |
| Continuous Monitoring | ✓ | **Limited** | ✓ |
| Non-Invasive | ✓ | ✓ | ✕ |
| Predictive Risk Stratification | ✓ | ✕ | ✕ |
| Cost Per Patient | **$199** | **$2,000+** | **$10,000+** |

| Comparative Advantage | CardioBound | LINQ | ZioPatch | MCT Patch |
|---|---|---|---|---|
| Real-Time AI Detection | ✓ | | | |
| Affordable (<$100) | ✓ | | | |
| Predictive Risk Stratification | ✓ | | | |
| No Surgery Required | ✓ | | ✓ | ✓ |




# 09 | Comparative Advantage

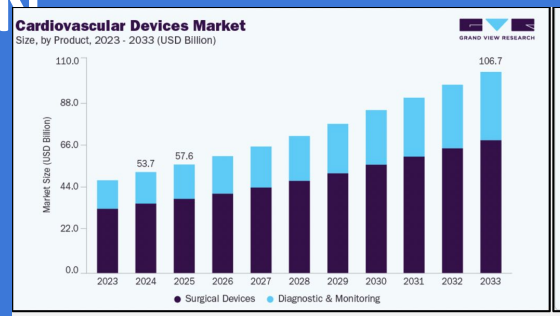
# USA MARKET SIZE

- AMERICANS WITH CARDIOVASCULAR DISEASE:

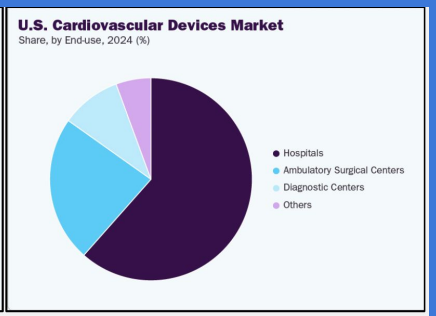
  **60 MILLION**

- DIAGNOSED ARRHYTHMIA CASES: **10.5 MILLION**
- UNDIAGNOSED ARRHYTHMIA CASES: **1.4 MILLION**
- U.S. CARDIOVASCULAR DEVICE MARKET VALUE:

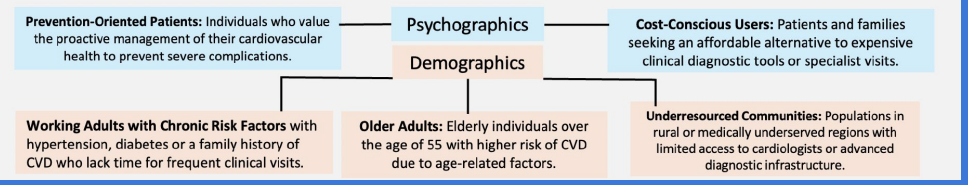
  **$53.7 BILLION**

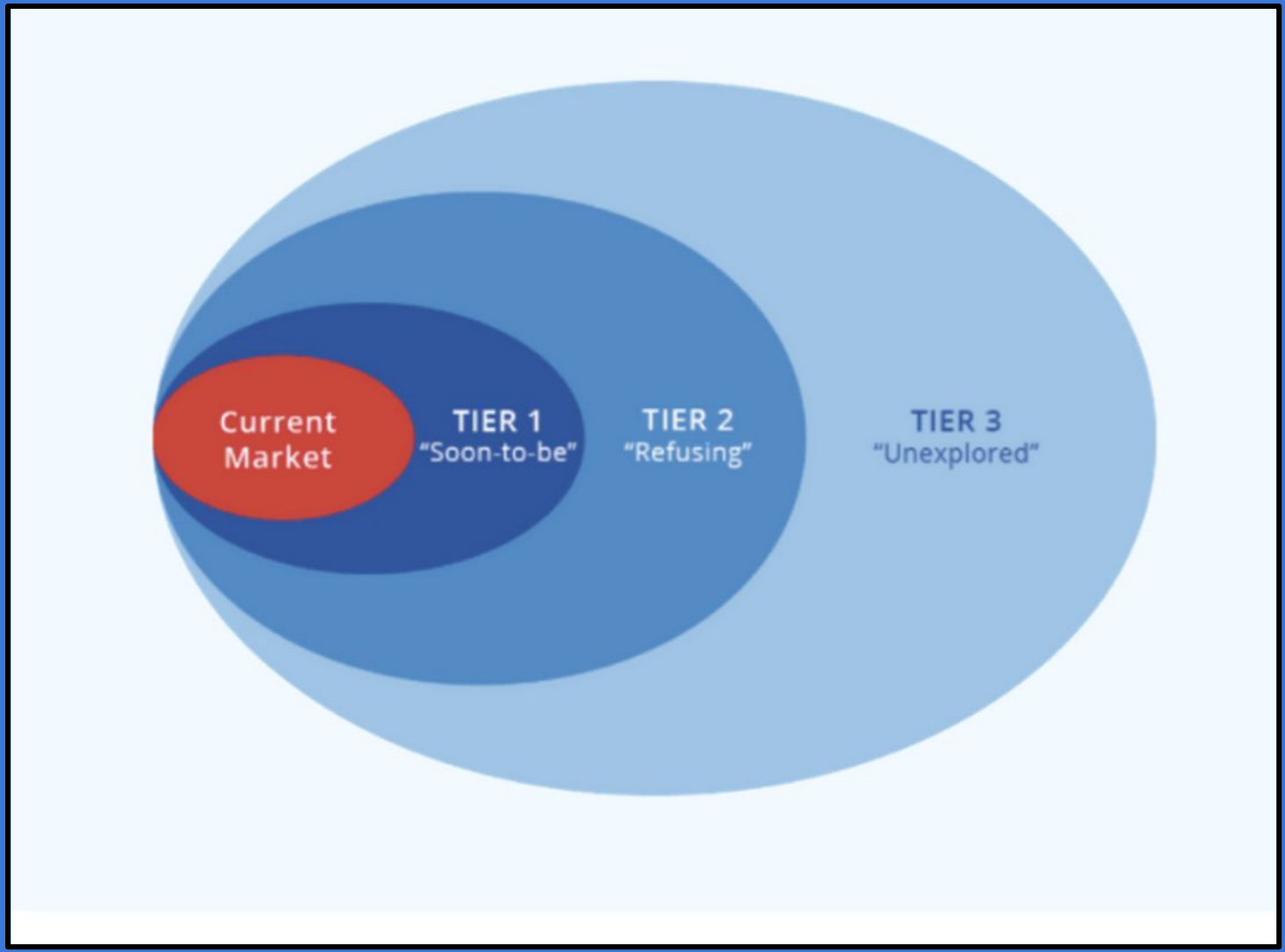




The global cardiovascular devices market shows growth from 2023 to 2033, due to the rising demand for diagnostic and monitoring technologies, reaching over $100B USD by 2033.




Hospitals dominated the cardiovascular devices market in 2024, with ambulatory surgical and diagnostic centers having smaller shares.






**Current Market –** Adults 55+ diagnosed with arrhythmias

**TIER 1 –** At-Risk Adults 55+

➔ Adults 55+ with elevated cardiac risk but not yet diagnosed

**TIER 2 – U**nderserved & Rural Adults 55+

➔ Older adults with limited access to cardiology care

**TIER 3 –** Proactive Older Adults 55+

➔ Health-conscious adults seeking preventive AI monitoring

# 11 | Target Market Evaluation

# LONG-TERM ROADMAP

**Q2 2026**
Launch software diagnostic layer for existing consumer wearables such as the Apple Watch

**Q4 2026**
Pilot studies with Mount Sinai and community health partners

**Q2 2027**
Regulatory guidance meetings and FDA pre-submission pathway planning

**Q4 2027**
Submit an FDA 510(k) for clinical-grade arrhythmia detection platform

**Q3-4 2028**
Commercial release with cardiology clinics and telemedicine integration

**Q2-4 2030**
Nationwide scaling through reimbursement insurance coverage and hospital partnerships

# Milestones

**June 2025** → **Present**

| | | | |
|---|---|---|---|
| **Software** | CNN-LSTM Diagnosis ✓ | XGBoost ✓ | Flutter Backend App V1 ✓ |
| **Outreach** | Cold Outreach ✓ | Physician Partnership ✓ | |
| **Hardware** | CAD Prototype Mockups ✓ | PCB Design with Sensor Integration ✓ | |

“Being able to monitor patients in an outpatient setting efficiently and cost-effectively with the help of AI would be extremely valuable. Early detection of irregular heart rates is crucial, as it can significantly reduce the risk of stroke. **CardioBound offers an innovative and effective solution in the field of cardiology. I fully support this technology** and its potential to improve patient outcomes.”

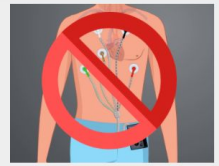
**Dr. James Ronaldson**

Interventional Cardiologist & Advisor on the Health First Heart Center Board

# JOIN US

to “**Guard Your Rhythm**”
and revolutionize cardiovascular disease prevention

If traditional monitoring fails…



**Holter Monitors**

**iRhythm ZioPatch**

**CardioBound can help!**

- ➔ **Modular**
- ➔ **AI-Optimized**
- ➔ **Scalable**
- ➔ **Continuous**

CardioBound

Always “**Guard Your Rhythm!**”
Help us revolutionize cardiac care!