

# CardieX

A Global Health Technology Company  
ASX:CDX

Breakthrough Algorithm  
Development for Monitoring  
Heart & Arterial Health  
with Wearable Devices



# WE HAVE DEVELOPED A WORLD-FIRST.

No commercially available consumer wearable can produce these medically reliable heart and arterial health features today.



# UNIQUE VALUE PROPOSITIONS

## World-First Feature Set of Enhanced Biometric Heart Health Measurements

### What We Are Introducing

- Consumer-friendly yet physiologically meaningful parameters not available anywhere else
- **Arty™ Score:** Combining Heart Stress, Heart Age and Exercise Capacity for a comprehensive heart and arterial health score
- **HR+:** medical-grade heart rate measurement

### How Did We Do It

- Developed algorithm to convert PPG signals to central BP pulse
- Physiologically meaningful parameters can be derived from central BP pulse
  - Accuracy is key
  - Comparison to ATCOR Medical's FDA-cleared gold-standard vital signs technology

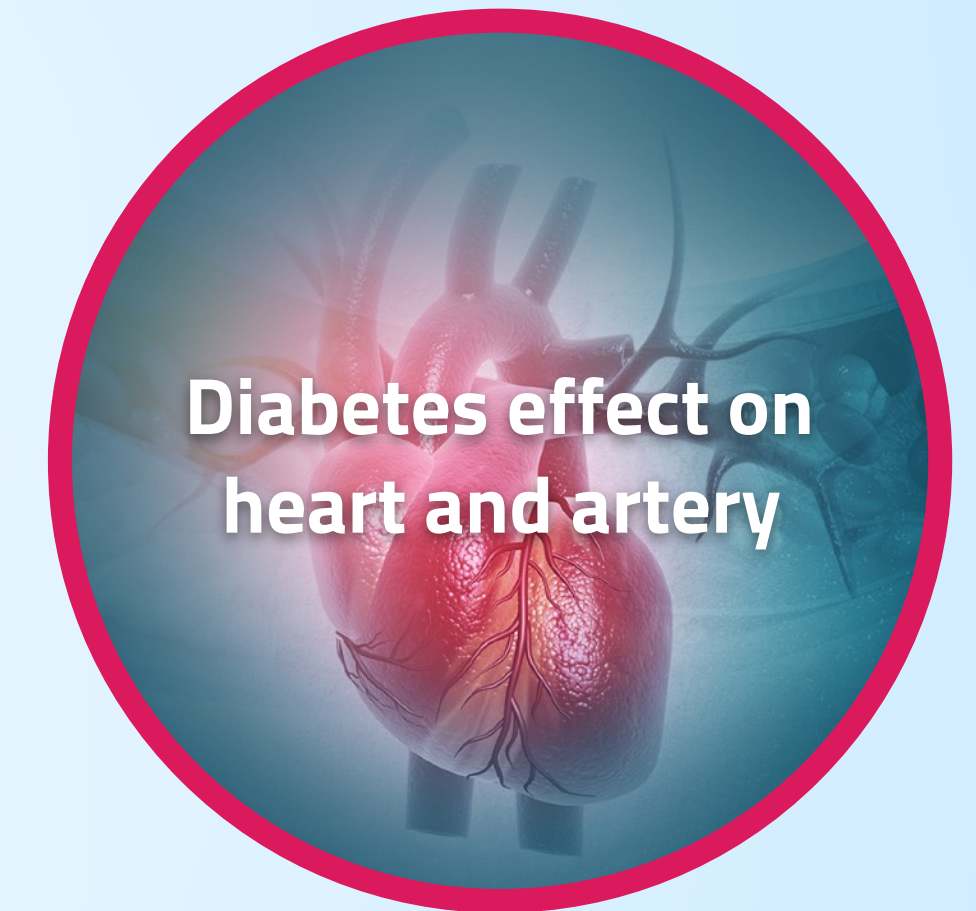
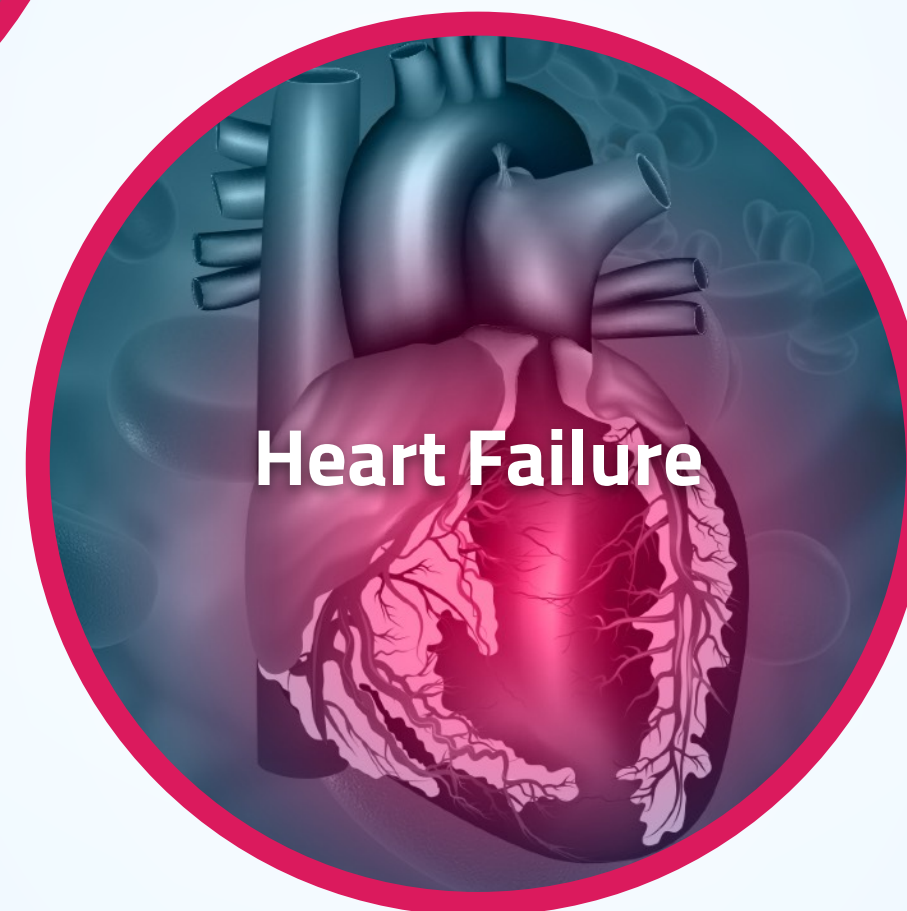
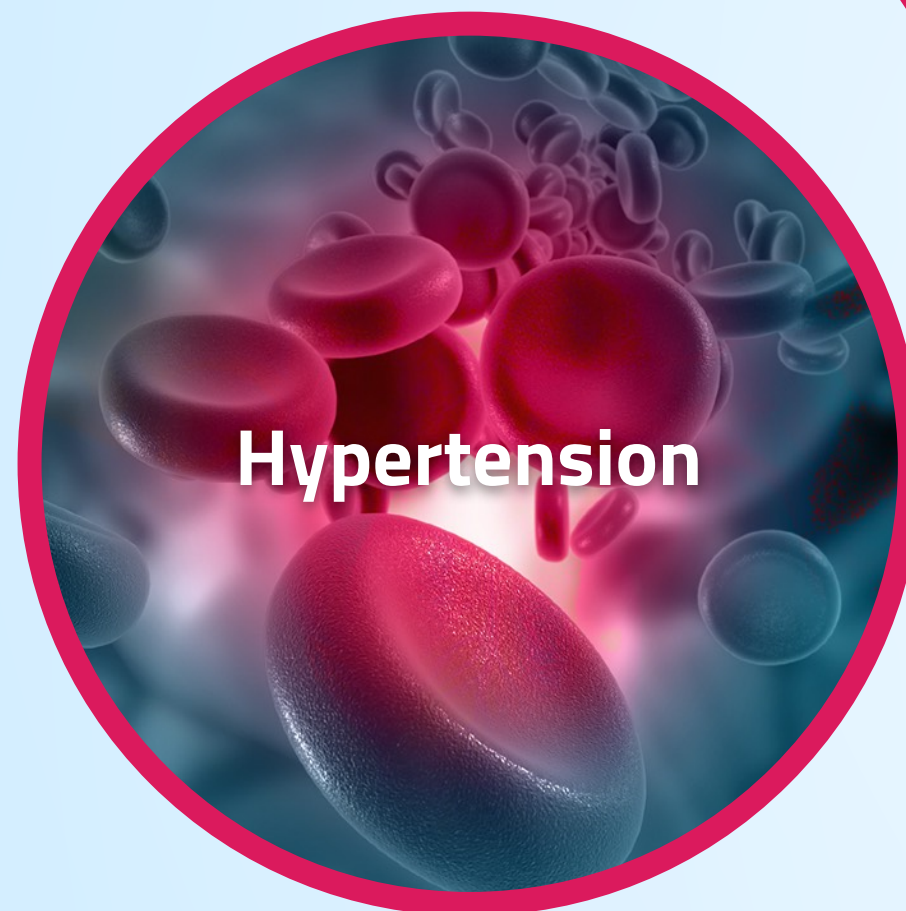
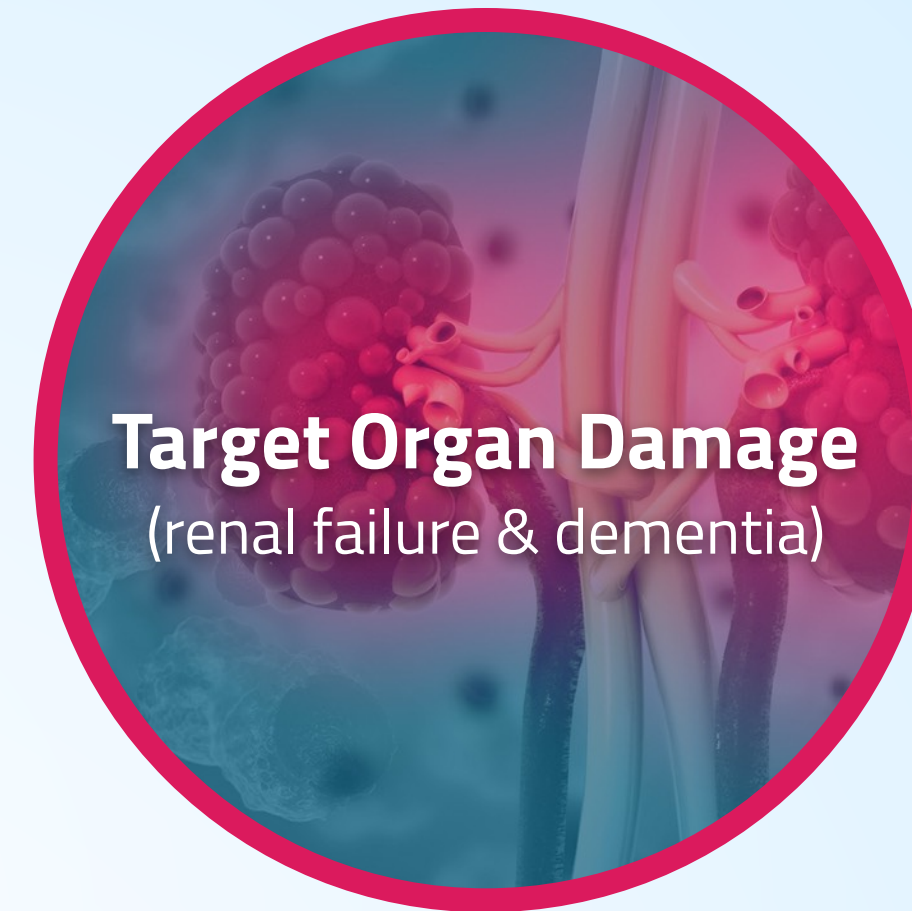
### Our feature set is based on known and established physiological facts

- Features from pressure pulse at the heart (aorta) are indicative of
  - Excess pressure at the heart (**Heart Stress**)
  - Heart and arterial age (**Heart Age**)
  - Capability of heart to deliver oxygenated blood (**Exercise Capacity**)

# HEART & ARTERIAL HEALTH FEATURES

Clinically Meaningful

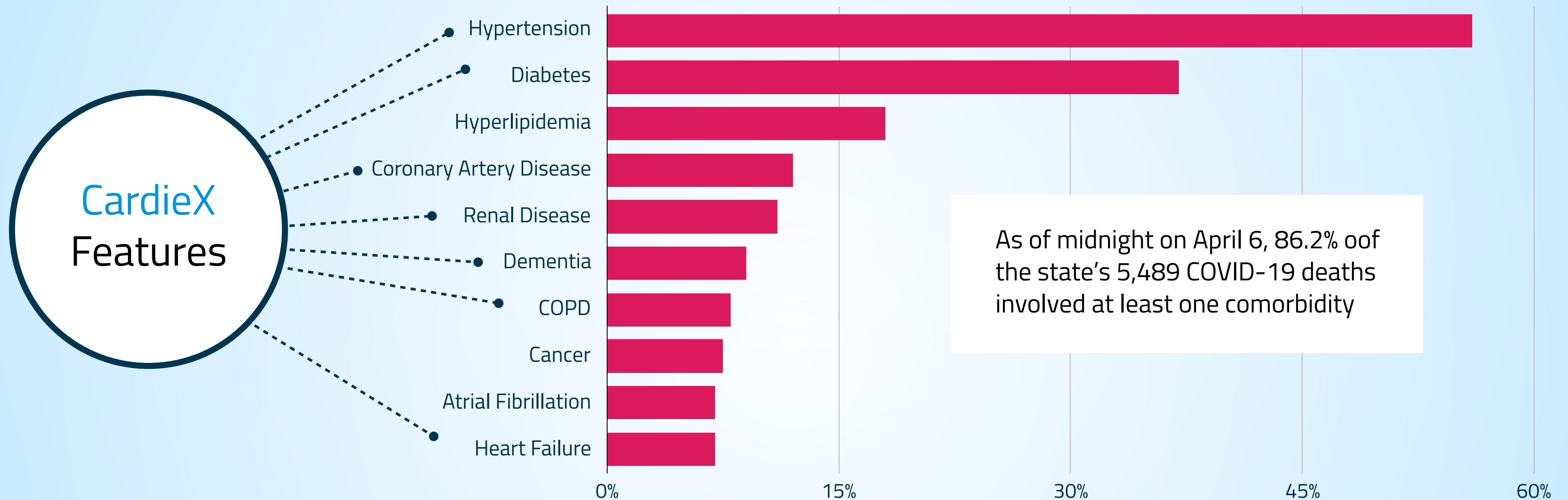
Early indicators of



Important to Monitor, Manage and Mitigate - **Even if Asymptomatic**

# RELEVANCE DURING PANDEMICS

Leading Comorbidities among COVID-19 Deaths in New York



Note: Data reported on a daily basis by hospitals, nursing homes, and other health care facilities.  
Source New York State Department of Health

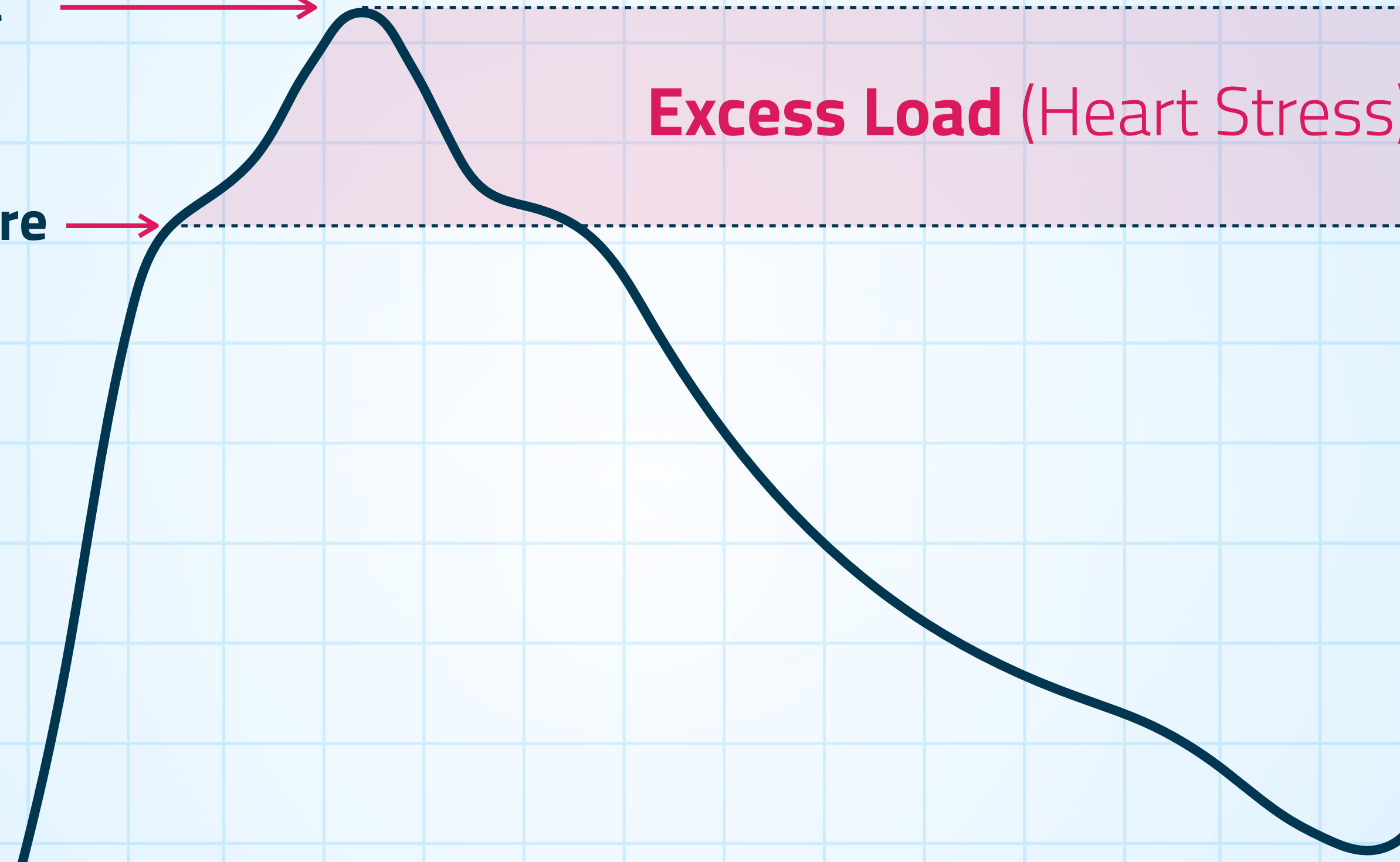
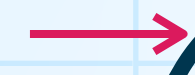
# HEART STRESS

Excess Pressure Load at the Heart

Pressure Pulse at the Heart



Max Heart Pumping Pressure



Excess Load (Heart Stress)

# HEART STRESS

Excess Pressure Load at the Heart

Healthy/Young

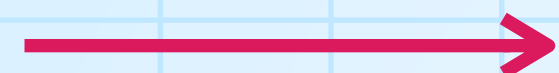
Not Healthy/Old



# HEART (ARTERIAL) AGE

To Compare with Actual Age

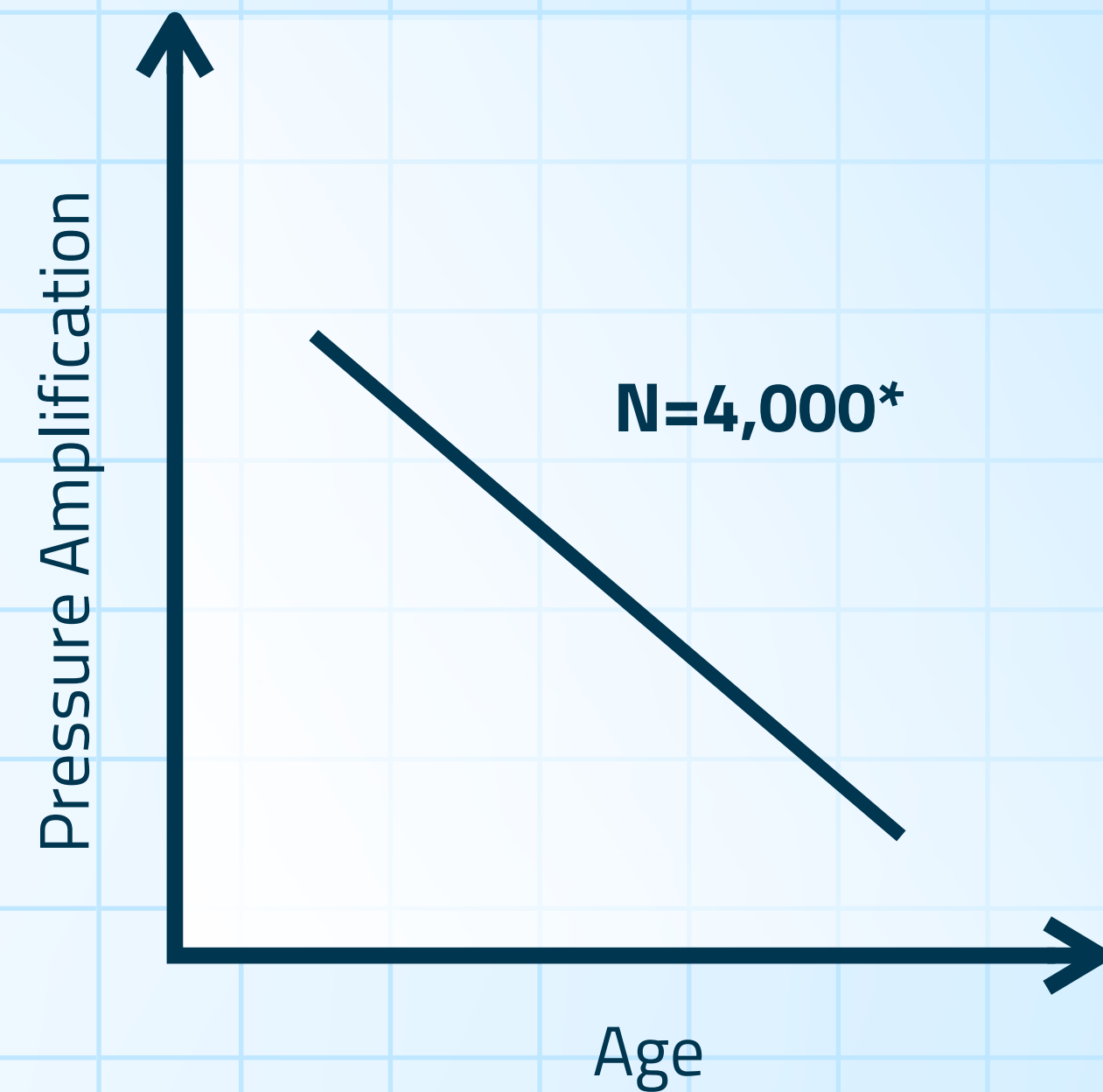
**Pressure Pulse  
at Upper Arm**



**Pressure Pulse at Heart  
(Aortic Pressure Pulse)**



Pressure  
Amplification



\* McEniery et al, The Anglo-Cardiff Collaborative Trial (ACCT), Journal of the American College of Cardiology 2005;46:1753– 60



# EXERCISE CAPACITY

Capability of Heart to Deliver Oxygenated Blood

Pressure Pulse at Heart  
(Aortic Pressure Pulse)

$$\text{Exercise Capacity} = \text{AUC2} / \text{AUC1}$$
$$= \text{Supply} / \text{Demand}$$

Demand  
(AUC1)

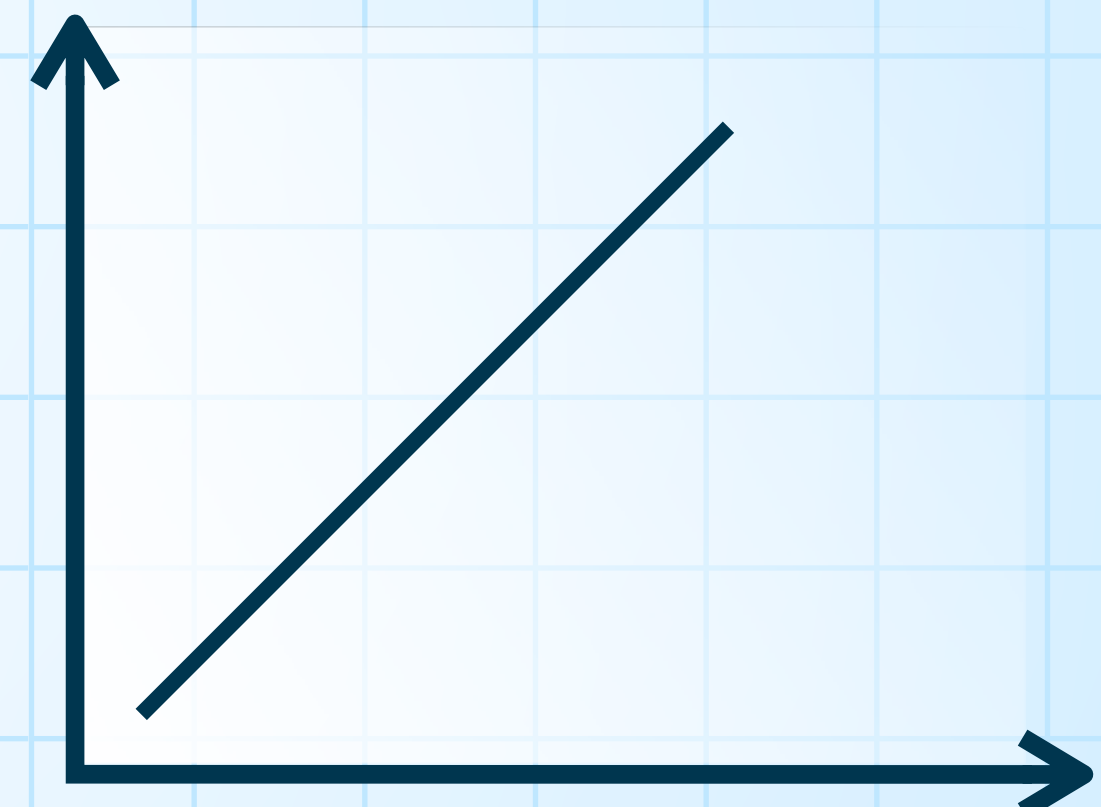
Supply  
(AUC2)

Exercise Capacity

Blood Ejection

Heart Perfusion

Physical Fitness &  
Endurance



# FEATURE SET SUMMARY

Enhanced Biometric Measurements from PPG Sensors



## Arty™ Score

**Comprehensive heart and arterial health score** that reflects the impact of arterial stiffness across the cardiovascular system. Calculation of **Arty™** takes into account Heart Stress (excess pressure to the heart), Heart Age (status of cardiovascular aging), Exercise Capacity (ability to supply oxygen), and Heart Rate Plus (beat-to-beat HR).



### Heart Stress

Measure of excess pressure on the heart due to hardening of arteries



### Heart Age

Comparison of heart and arterial age to actual biological age



### Exercise Capacity

Ability of heart to provide sufficient oxygenated blood based on overall demand in the body



### Heart Rate Plus (HR+)

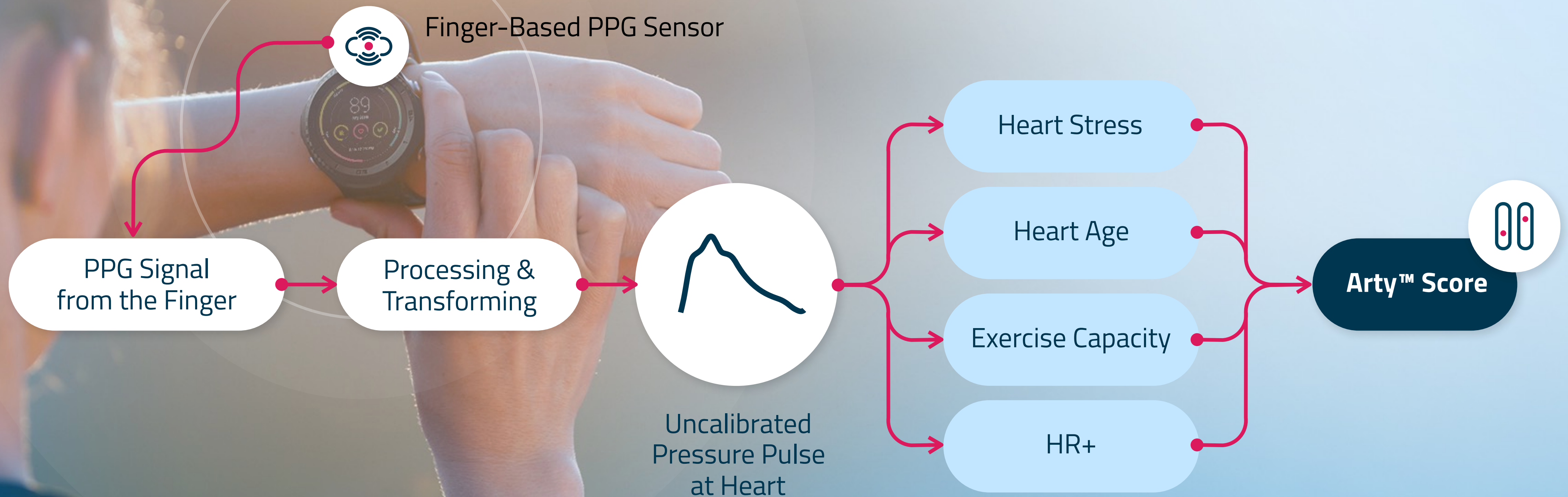
Accurate medical-grade, beat-to-beat heart rate (equivalent to medical ECG method)

# OUR DEVELOPMENT PROCESS

Built on the foundation of our FDA-cleared gold-standard **SphygmoCor**® algorithm set.

# DERIVING HEART & ARTERIAL INDICATORS

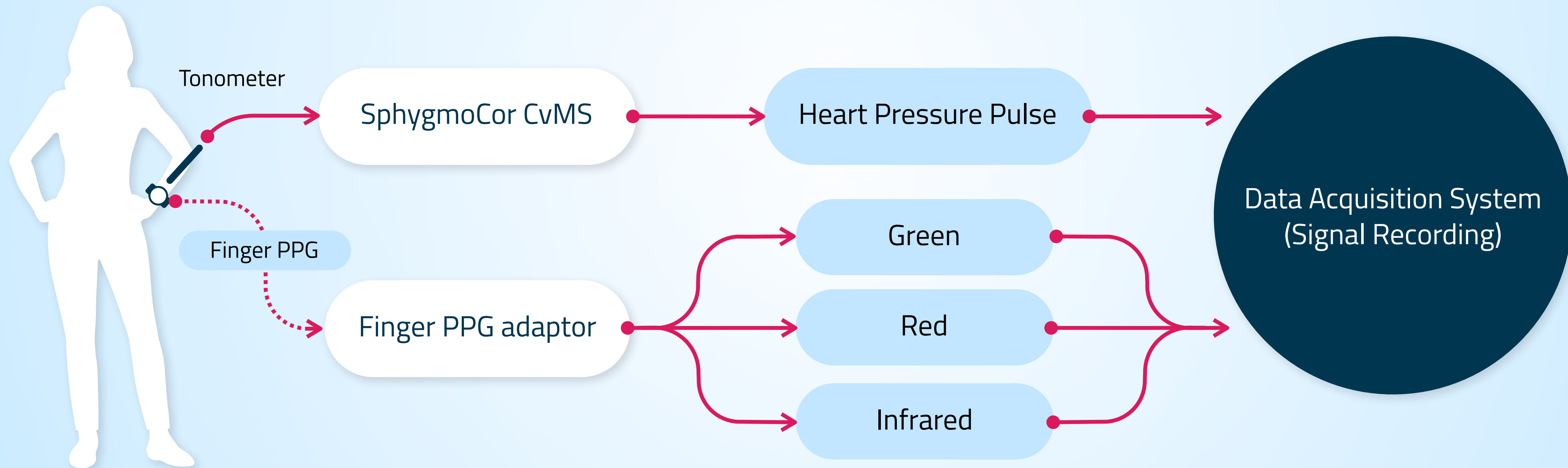
Calculated from Heart Pressure Pulse from Mobvoi's Finger-Based PPG Sensor



# COLLECTING DATA

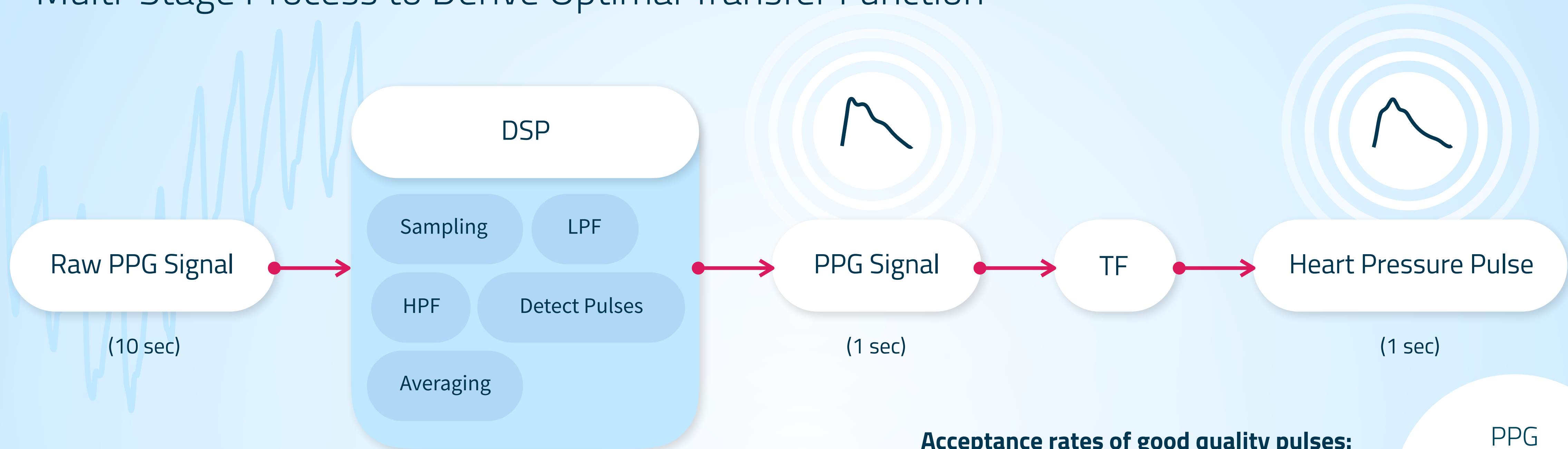
## Signals Utilized and Subject Demographics

- Recorded PPG signals (green, red, infrared) from the finger and the FDA-cleared, gold-standard SphygmoCor heart pressure pulse from wrist tonometer signal simultaneously.
- 13 subjects (4F, 9M), ages 20-65, 3 to 9 recordings (10 seconds) for each subject.
- Wide range of heart pressure pulse shape (young, old, healthy, not healthy).



# ALGORITHM DEVELOPMENT

Multi-Stage Process to Derive Optimal Transfer Function



- Digital Signal Processing (DSP) on PPG signals from the finger.
- PPG signal to heart pressure pulse transfer function (TF) estimated from 9 recordings and tested on the other 55 recordings.
- 10 to 15 TFs were estimated for each PPG wave (green, red, IR) and one TF was selected for PPG wave.

Acceptance rates of good quality pulses:

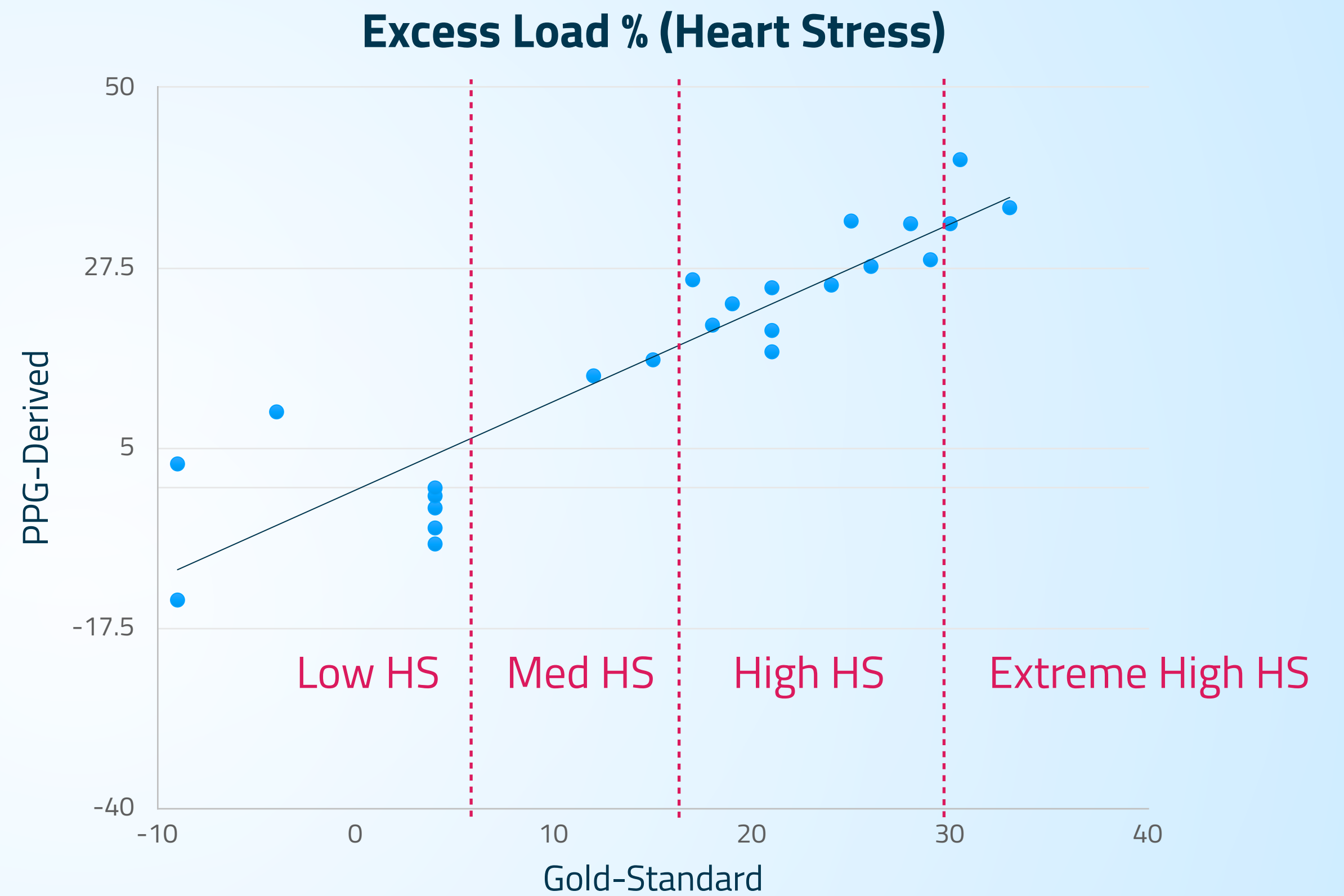
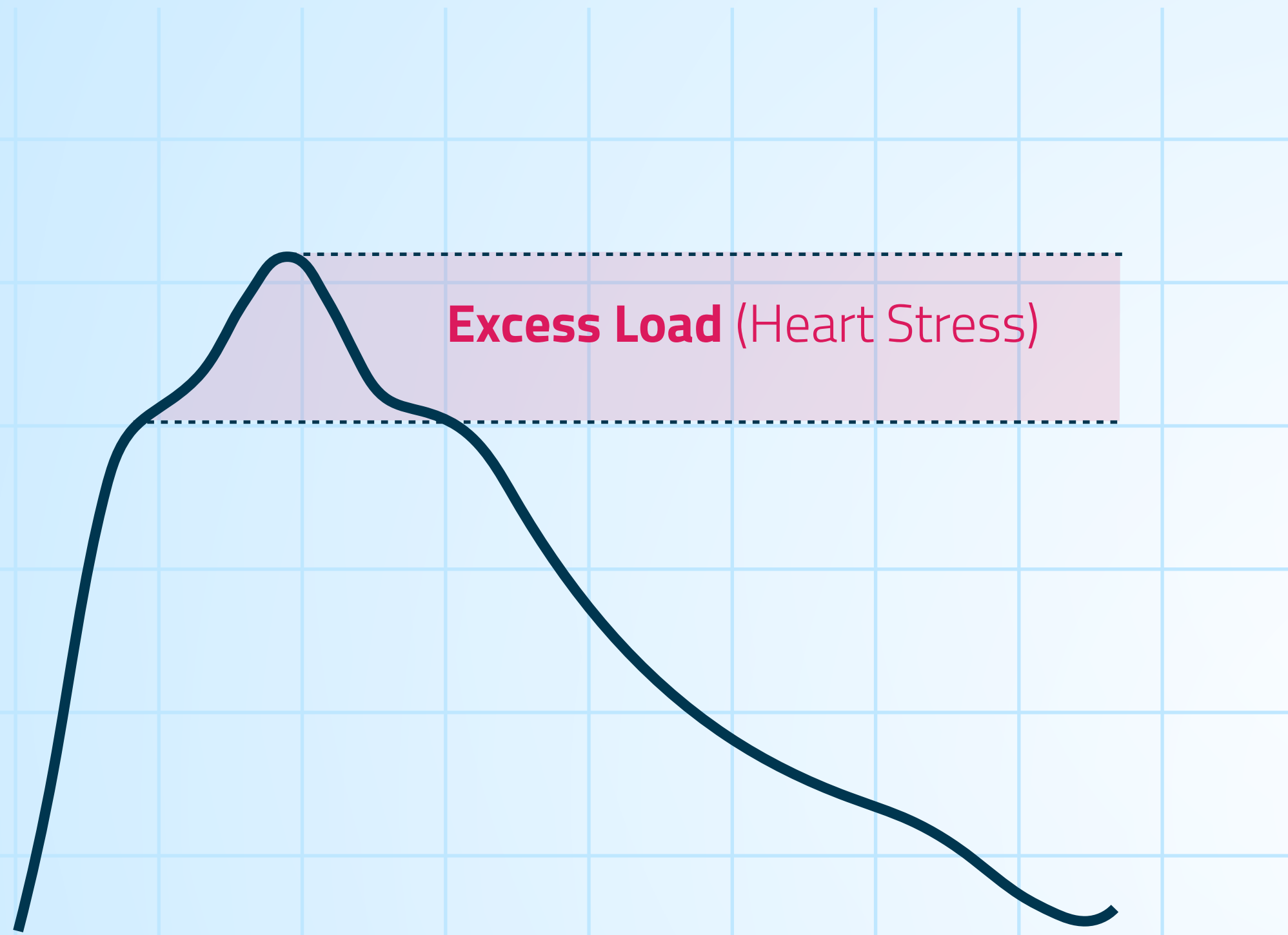
Signal	Acceptance Rates
Green	95%
Red	70%
Infrared	85%

PPG  
**GREEN**  
TF produced best results

# HEART STRESS

Results Comparing PPG-Derived to Gold-Standard Measurement

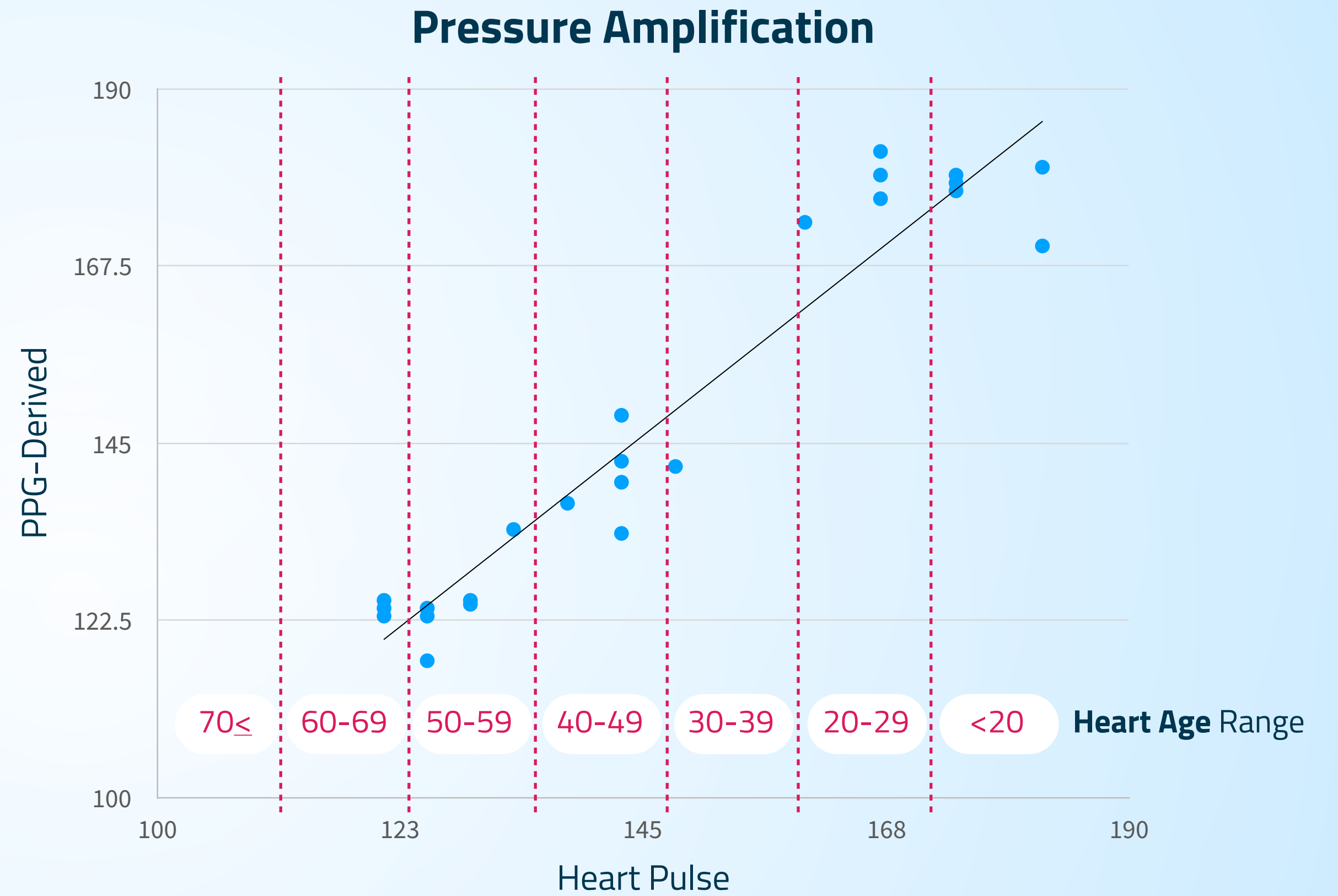
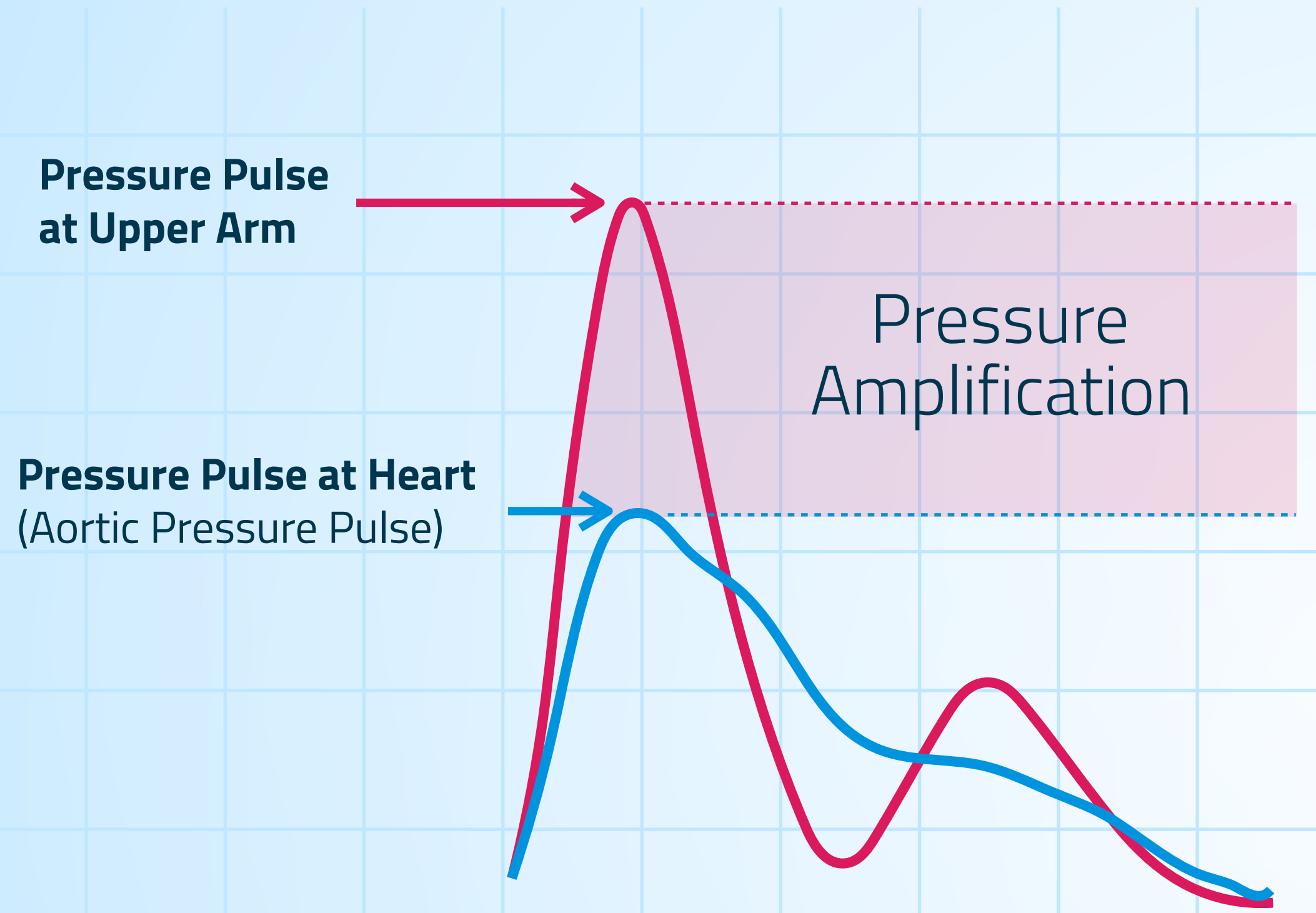
Correlation=0.91  
Ave Diff=1±6 %



# HEART AGE

Results Comparing PPG-Derived to Gold-Standard Measurement

Correlation=0.96  
Ave Diff=1±6 %

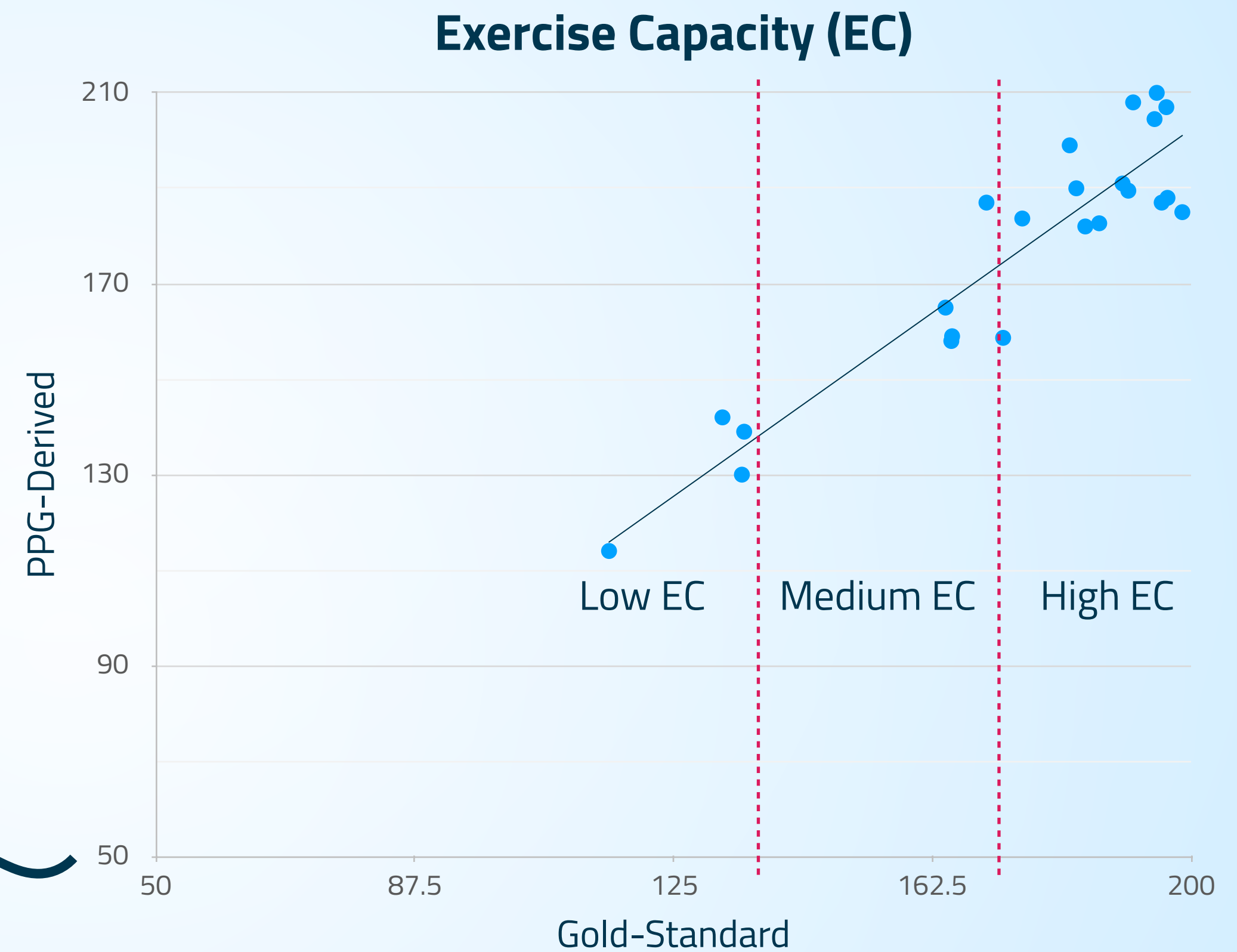
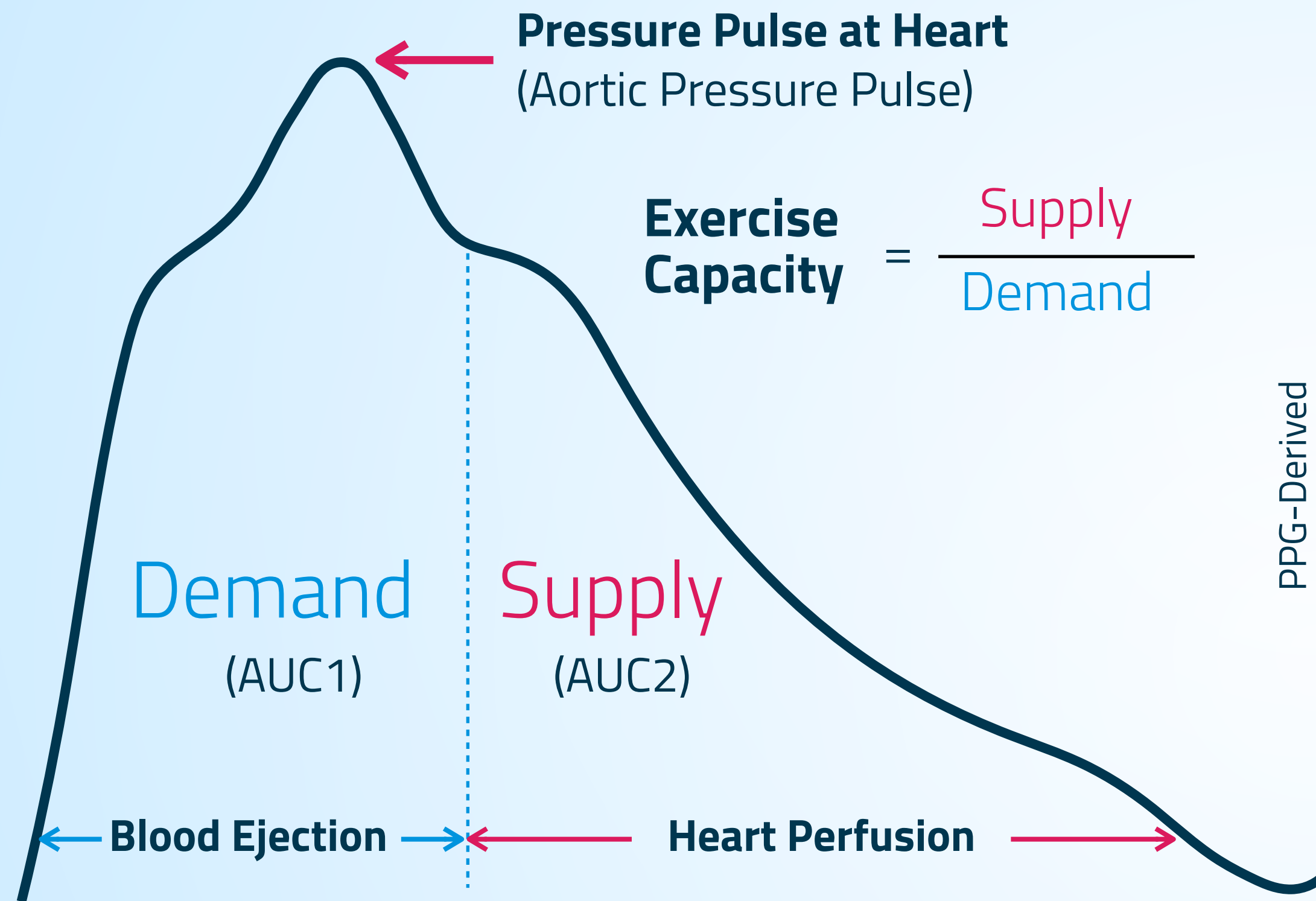




# EXERCISE CAPACITY

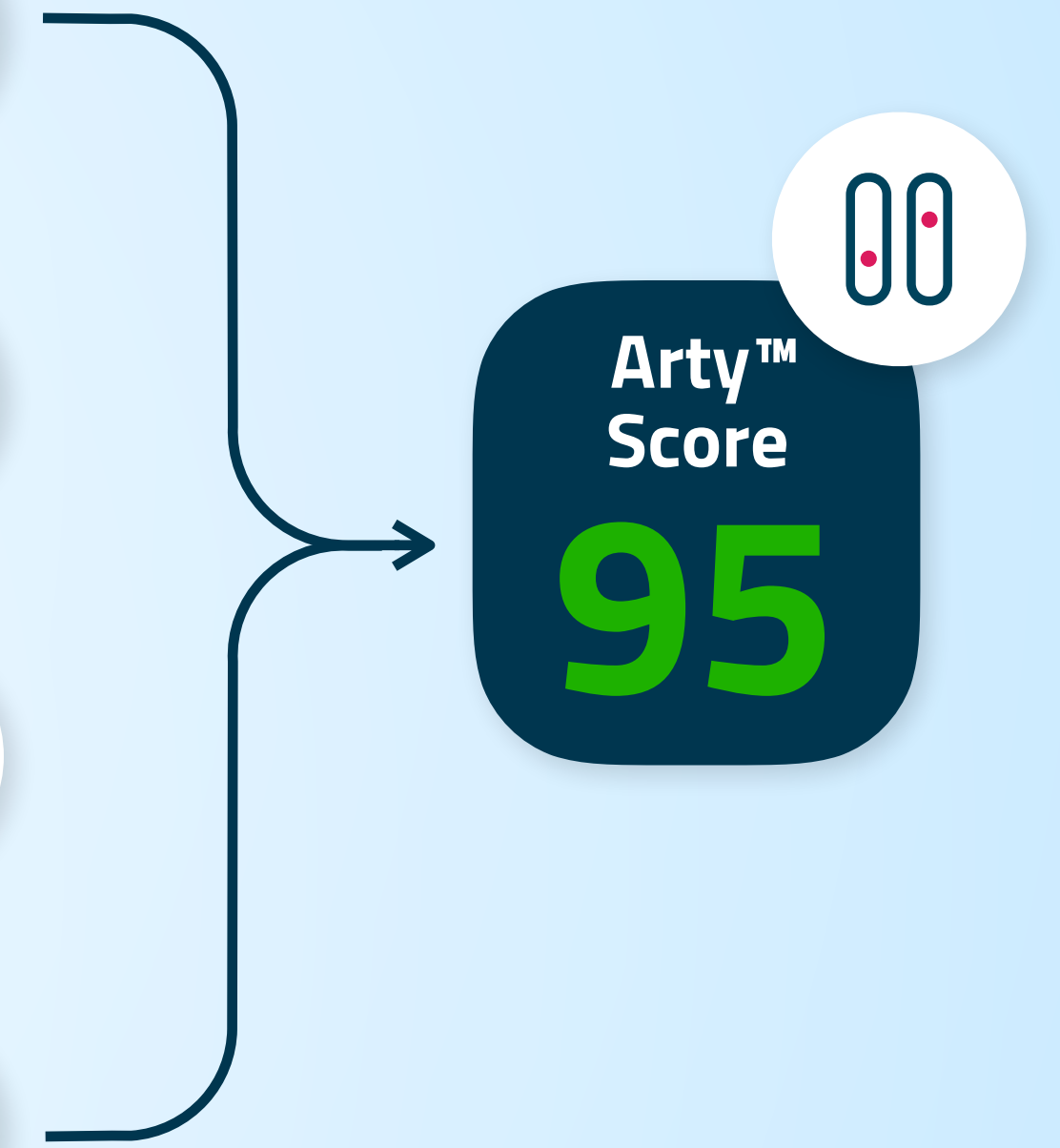
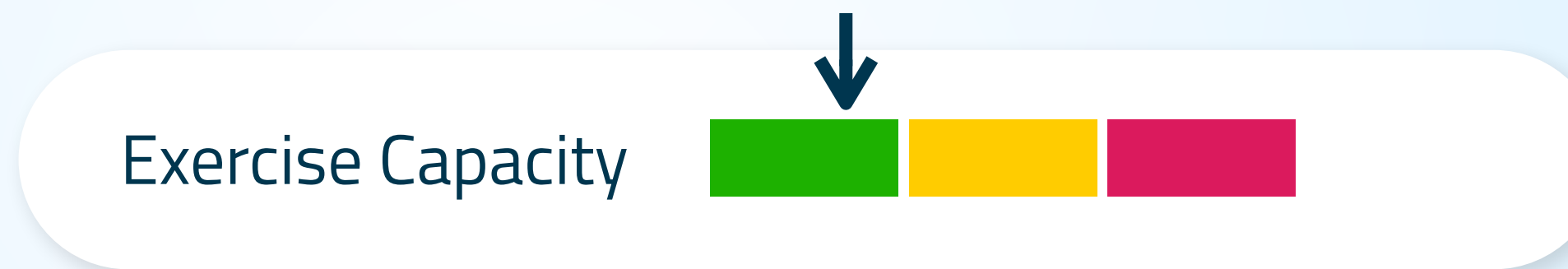
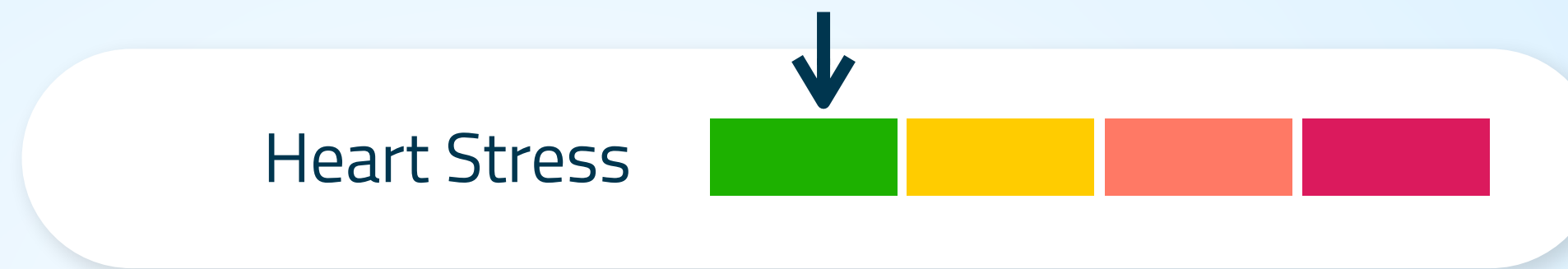
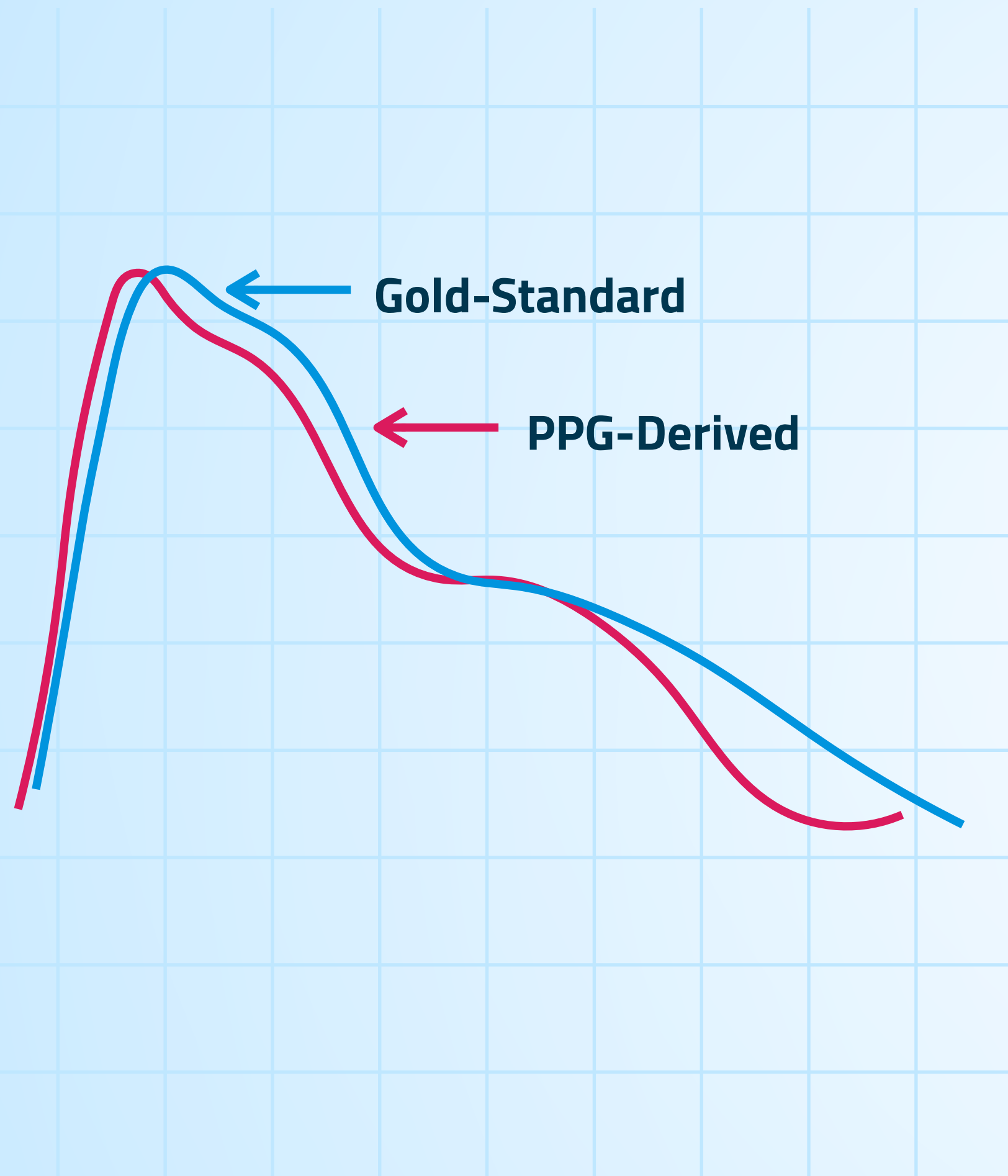
Results Comparing PPG-Derived to Gold-Standard Measurement

Correlation=0.94  
Ave Diff=1.5±7 %



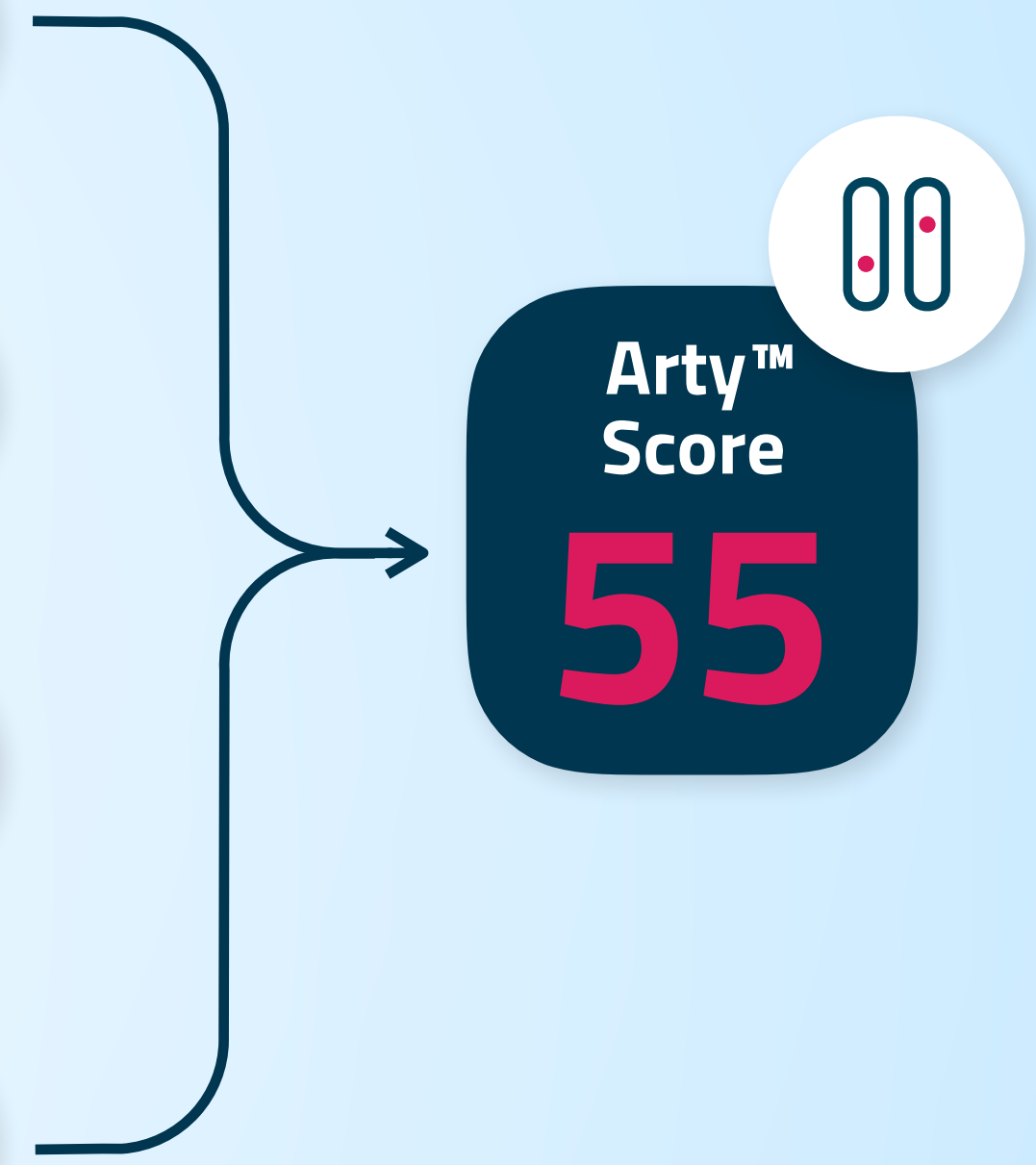
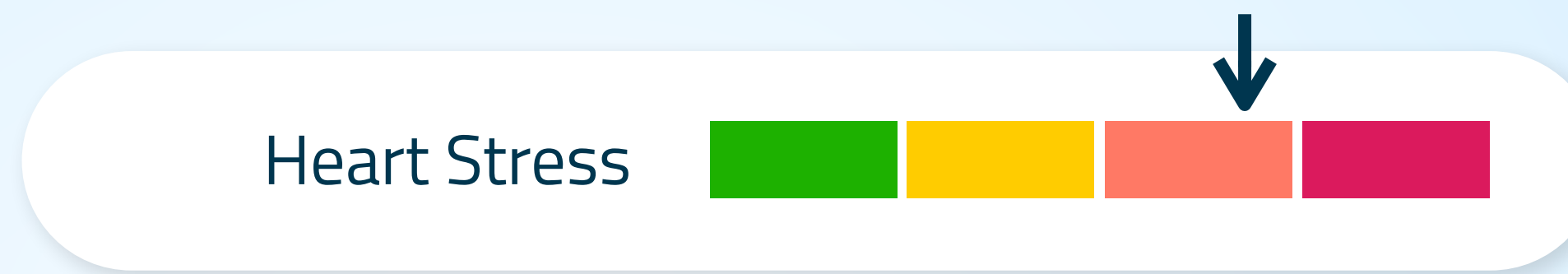
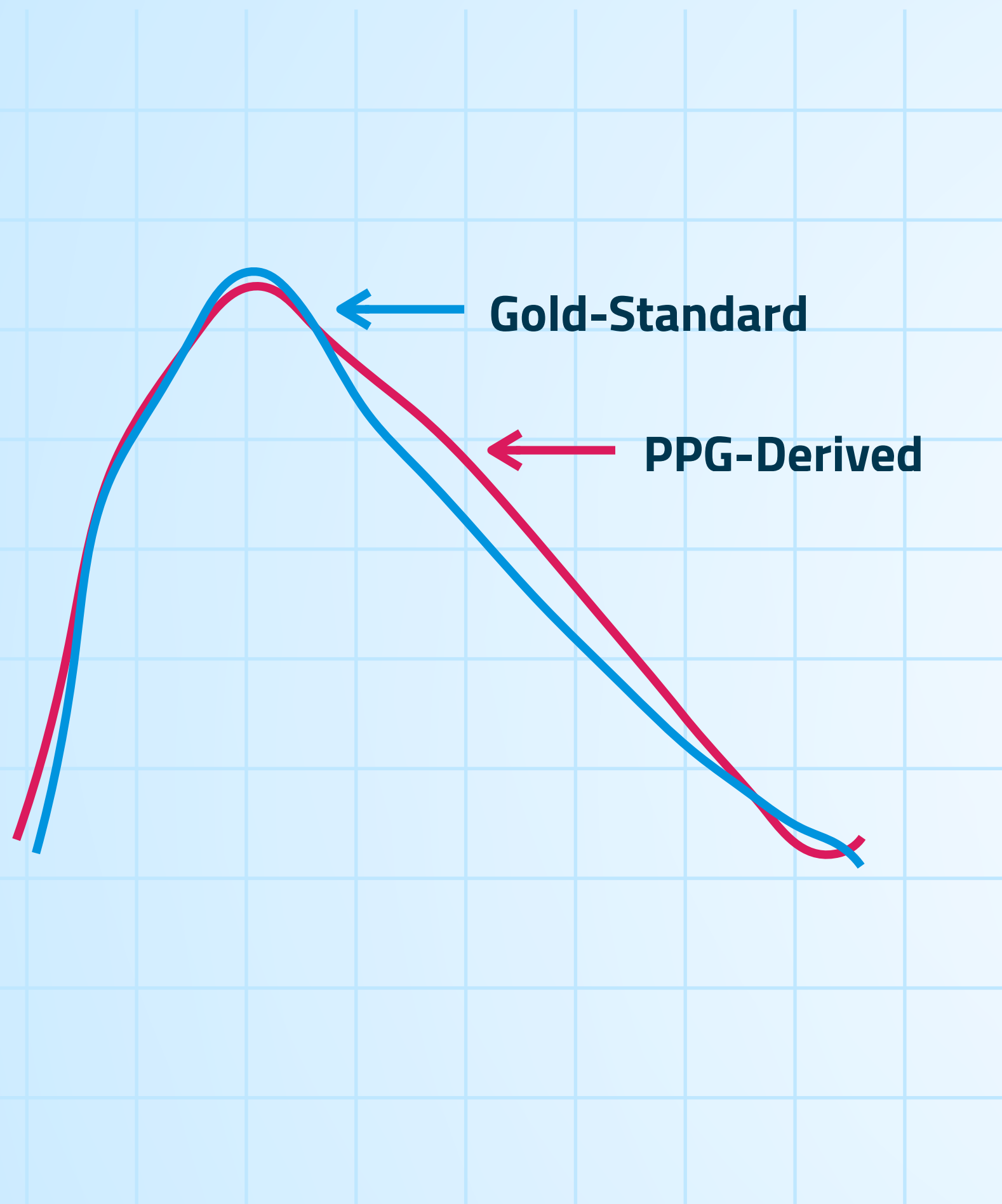
# EXAMPLE OF HEALTHY SUBJECT

Waveform Comparison, Resulting Measurements and Arterial Health Scoring



# EXAMPLE OF UNHEALTHY SUBJECT

Waveform Comparison, Resulting Measurements and Arterial Health Scoring



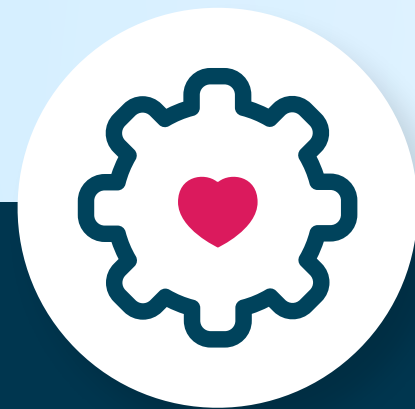
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### Heart Age

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### Exercise Capacity

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### Heart Rate Plus (HR+)

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# PHASE 2 DEVELOPMENT

Q1/Q2 2021



**Irregular Heart Beat (atrial fibrillation)**  
Identifying irregular heart rhythm without use of ECG.



**Arterial Stiffness**  
Quantifying hardening of arteries using central BP pulse.



**Heart Rate Variability (HRV)**  
Measuring variation in time between each heartbeat.



**Blood Pressure**  
Collecting PPG data on human subjects to assess tracking with BP.



**Central Pulse Pressure**  
Characterizing this known marker for cardiovascular risk.

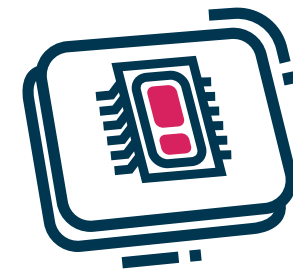


**Cardiac Efficiency**  
Calculating efficiency in supplying oxygenated blood to support peak performance.



# DEMONSTRATION KIT

Currently in Development



- Integrated circuit board with PPG sensor
- Collect pulse signals with sensor and send raw data to PC



- Raw data from PPG sensor is stored on PC
- Use downloadable app (on CardieX.com) to convert raw data and display proprietary heart and arterial health parameters



- Demo Kit user guide
- Data collection support
- Technology whitepapers



# INTERESTED IN INTEGRATING OUR HEART & ARTERIAL HEALTH FEATURES?

Contact us: [zlin@cardiex.com](mailto:zlin@cardiex.com)