

# Cardiovascular Markers for Routine Daily Practice Risk Assessment

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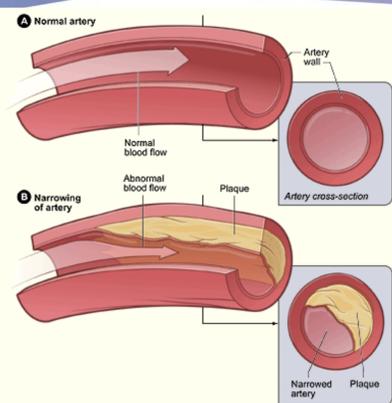


Fig. 1 – Normal (A) and Partially Blocked(B) Blood Vessels.

## Motivation

Noncommunicable diseases (NCD) are the leading cause of morbidity, mortality, early disability, and growing health costs worldwide. From those, Cardiovascular diseases (CVDs) are the leading cause of death accounting for more than 16 million deaths from ischemic heart disease and stroke alone (1). In response to this crisis the world health organization (WHO) proposed a global plan for the prevention and control NCDs 2013–2020 (2). This plan calls for actions for the risk mitigation for CVD call for a full cardiovascular risk assessment approach to be started during routine medical practice. To achieve this plan two main venues must be taken: one is the need for universally accepted “gold-standard” indicators of arterial injury and cardiac dysfunction that can be readily and reliably used, one of these markers is the carotid-femoral pulse wave velocity (cfPWV). The other being the development of simple devices that can implement the monitoring of such indicators. This poster presents 3 concurrent approaches that are being developed to address this issue, the development of a low-cost monitoring device and the evaluation of different cardiovascular markers, such as, Cardio-Ankle Vascular Index (CAVI), Pulse Wave Velocity (PWV), Central Arterial Pressure (CAP) and Heart Rate Variability (HRV).

## Cardiovascular Markers

### CAVI and PWV – Arterial Stiffness Evaluation

Arterial stiffness can be used as an indicator for the development of cardiovascular disease. PWV is the **gold standard** marker of arterial stiffness (measured on carotid and femoral arteries); however, his procedure is not always easy to perform, and requires some clinical training. The cardio-ankle vascular index (CAVI) is another most recent cardiovascular marker that as been proposed for the evaluation of arterial stiffness. Its simplicity of measurement and its tolerance to changing arterial blood pressure makes it a candidate for cardiovascular risk evaluation in routine clinical practice (3).

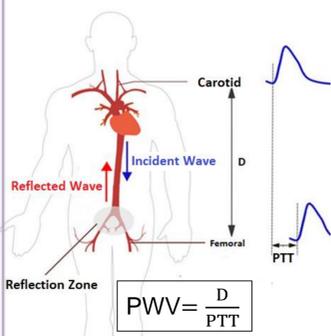


Fig.2 – PWV measurement.



Fig.3 – CAVI measurement.

### CAP – Central Aortic Pressure

The effects caused by vasoactive drugs are different in central and peripheral pressures; and the traditional method of CAP assessment consists of an invasive cardiac catheterization procedure. So, the implementation of our novel device for non-invasive measurements of Central Aortic Pressure into clinical routine is very important.



Fig.4 – Validation of non-invasive CAP against invasive measurements by catheters.

### HRV

Heart rate variability (HRV) is a well-established marker of the autonomic nervous system function. Reduced HRV has been linked with cardiovascular disease and its risks factors, such as hypertension and diabetes. The HRV can be obtained from the ECG and the PPG by measuring the time intervals between the R-peaks and the systolic peaks, respectively.(5)

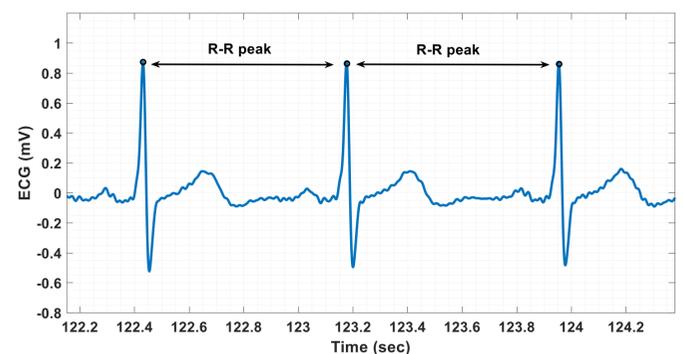


Fig. 5 – ECG Signal

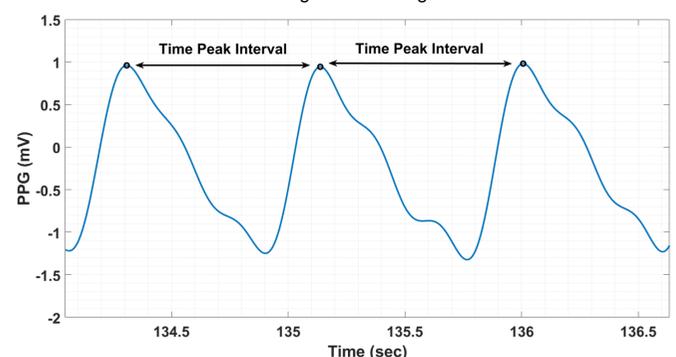


Fig. 6 – PPG Signal

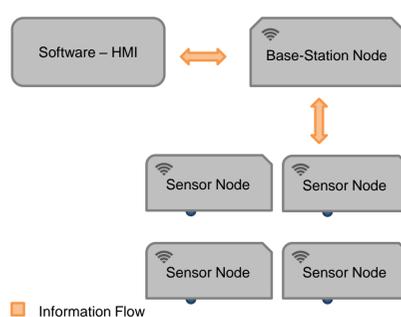
## Devices

The VasoCheck<sup>®</sup> System is a tested device that is being further developed to accommodate several types of pulse signal recordings (4):

- Pulse wave Photoplethysmography (PPG).
- Heart-Sounds (Phonocardiogram).
- Electrocardiogram (ECG).

Fig. 7 – VasoCheck<sup>®</sup> system diagram and measurement of cfPWV.

### Multi-channel Hemodynamic Monitoring System



## References

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