

# Intercontinental Grouping of Accountants and Lawyers

Frankfurt/Main (Mainhattan), Sept. 26<sup>th</sup>, 2019

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**Cardiovascular monitoring by fitness trackers and  
(smart) watches today – boon and bane.**

*Thomas Wendt*



# Disclosures

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Gutachter

Autor

kein öffentliches Amt

## Offenlegung finanzieller Beziehungen zu:

AstraZeneca	Scientific Board
Bayer	Referententätigkeit
Berlin Chemie	Referententätigkeit
Boehringer Ingelheim	Referententätigkeit
Bristol-Myers Squibb	Referententätigkeit
Daiichi Sankyo	Referententätigkeit
Pfizer	Referententätigkeit
Sanofi	Referententätigkeit
Solvay	Referententätigkeit
FAFA-Sponsoren	Referententätigkeit

## Offenlegung unvergüteter Tätigkeiten für:

Deutsche Herzstiftung	Mitglied des Wiss. Beirats
Hessischer Rundfunk	Sachverständiger
Hess. Tennisverband	Anti-Dopingbeauftragter
J.W.Goethe-Universität	apl.-Professur
Personal MedSystems	wiss. Kooperation
Infarct Protect	wiss. Kooperation
S + B medVET	wiss. Kooperation

# Cardiovascular monitoring – where and when ?

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**Vital parameters**

**CPU**

<b>Temperature</b>	<b>measured in the ear (or rectally)</b>
<b>Blood pressure</b>	<b>measured by oscillometry (or intraarterial)</b>
<b>Heart rate</b>	<b>derived from ecg or from</b>
<b>O<sub>2</sub>-saturation</b>	<b>measured by oxymetry (or arterial blood gas test)</b>



# Vital parameter: oxygen saturation

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Principle of Oxymetry: oxygenated and deoxygenated Hb show a different absorption and light emission which leads to such a



Fingertip pulse oxymeter



Wrist watch based 24/7  
fingertip pulse oxymeter

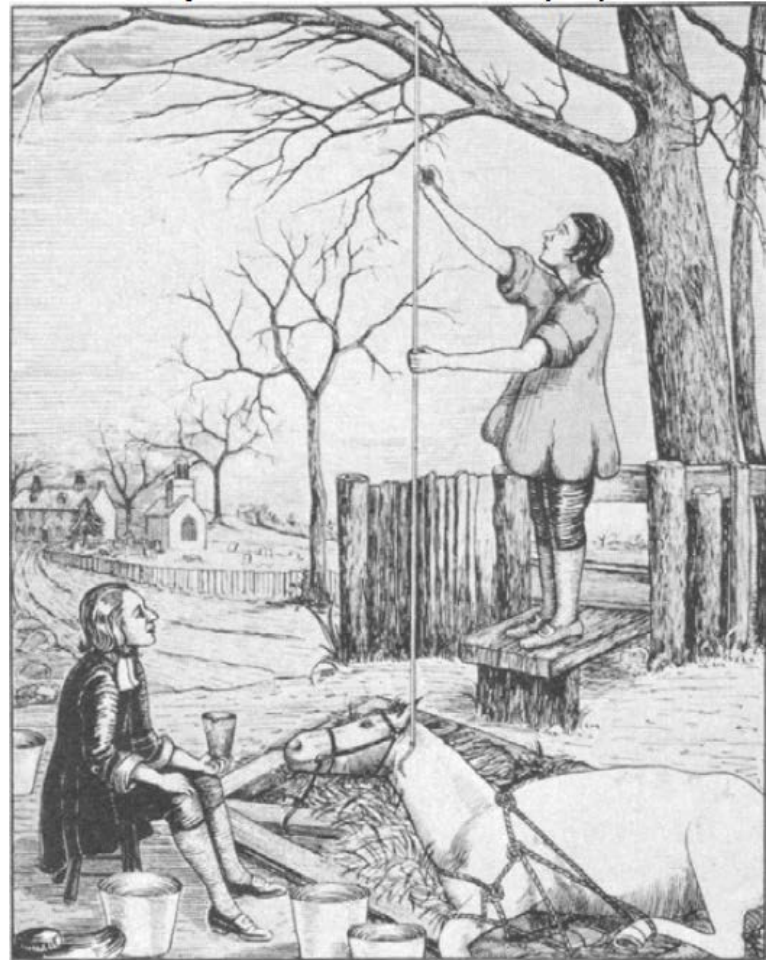


# Vital parameter: bp-measurement 286 years ago

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The first blood pressure measurement was performed 1733 by Stephen Hales, who was a deputy vicar in Teddington, England.

He inserted a messingtube in the cervical artery of a fixated horse, which was connected with a 3 m high glas tube, in which the animals blood pulsated – the higher it reached → the higher the blood pressure was.



# **Vital parameter: blood pressure measurement today**

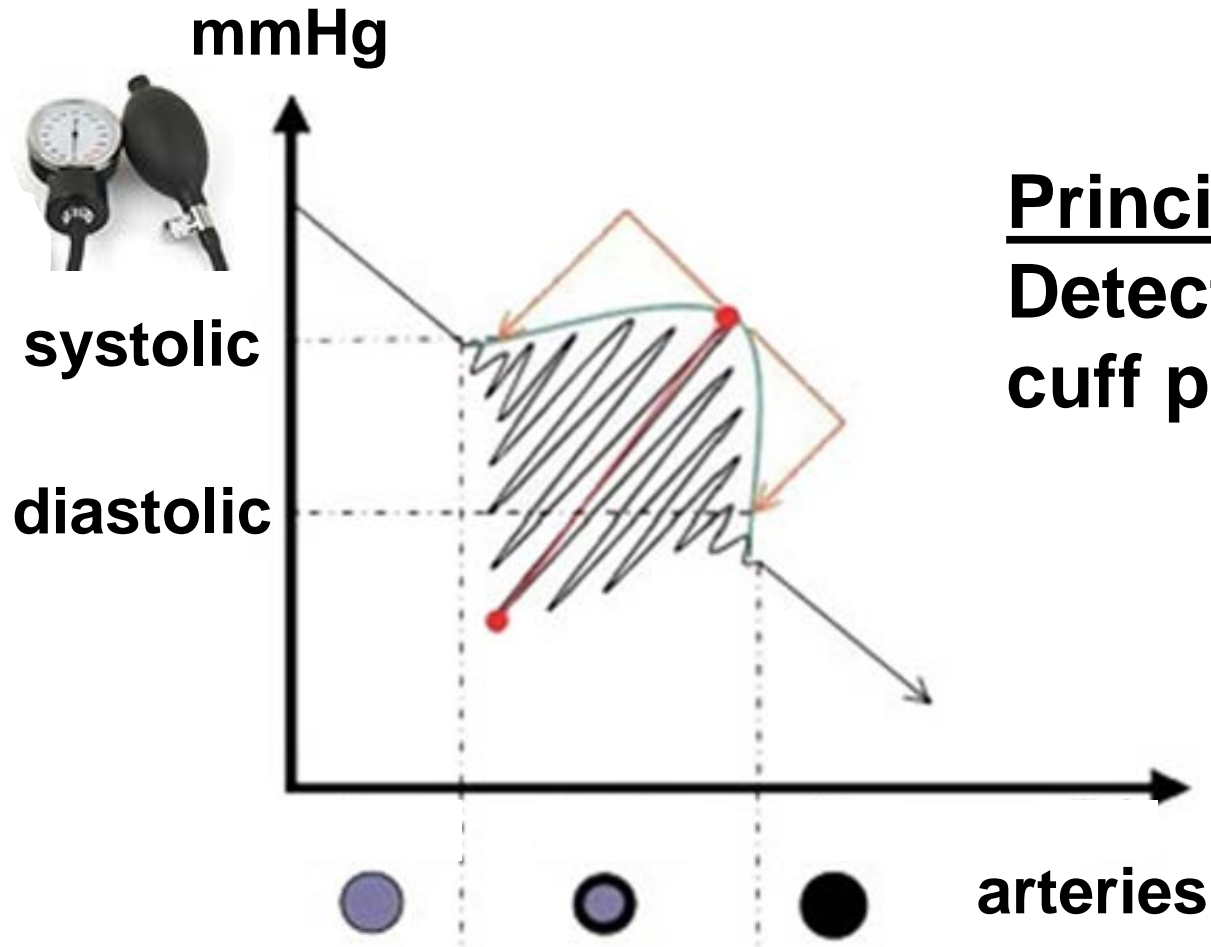
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**Unbloody, with Velcro closure, inflatable cuff and oscillometry,  
manually or automatic**



# Blood pressure measurement by oscillometry

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Principle of oscillometry:  
Detection of  
cuff pressure oscillations



# Blood pressure measurement by oscillometry

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121/82.104



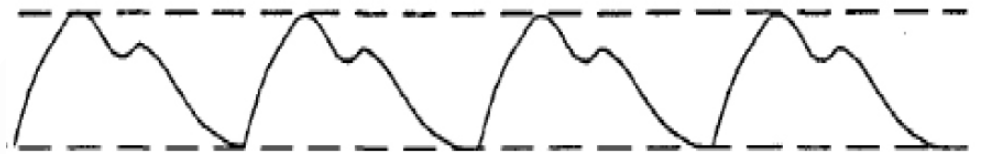


# Heart rate

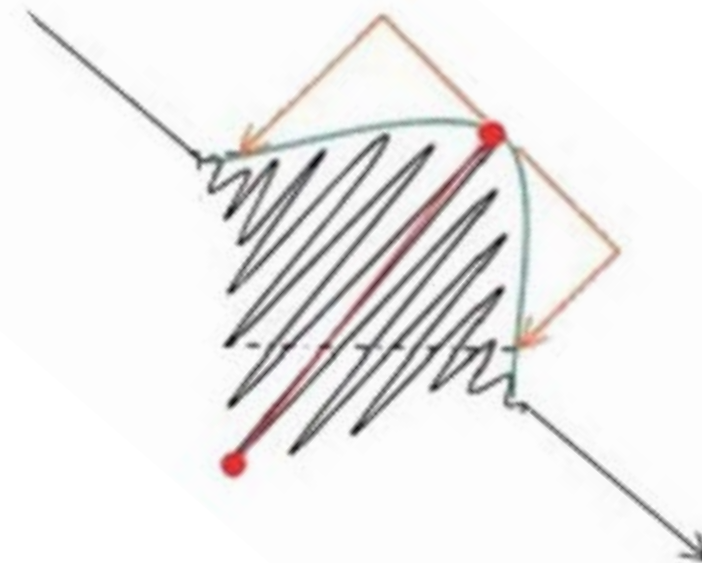
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The cardiovascular parameter heart rate can be derived

1) from the oxymetry curve



2) the oscillation curve



# Heart rate

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**furthermore, the heart rate can be derived**

**3) from the ecg**

**4) the photoplethysmogramm**



# The photoplethysmogram (PPG) is used for Optical heart rate tracking (OHR)

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## Principle of photoplethysmography:

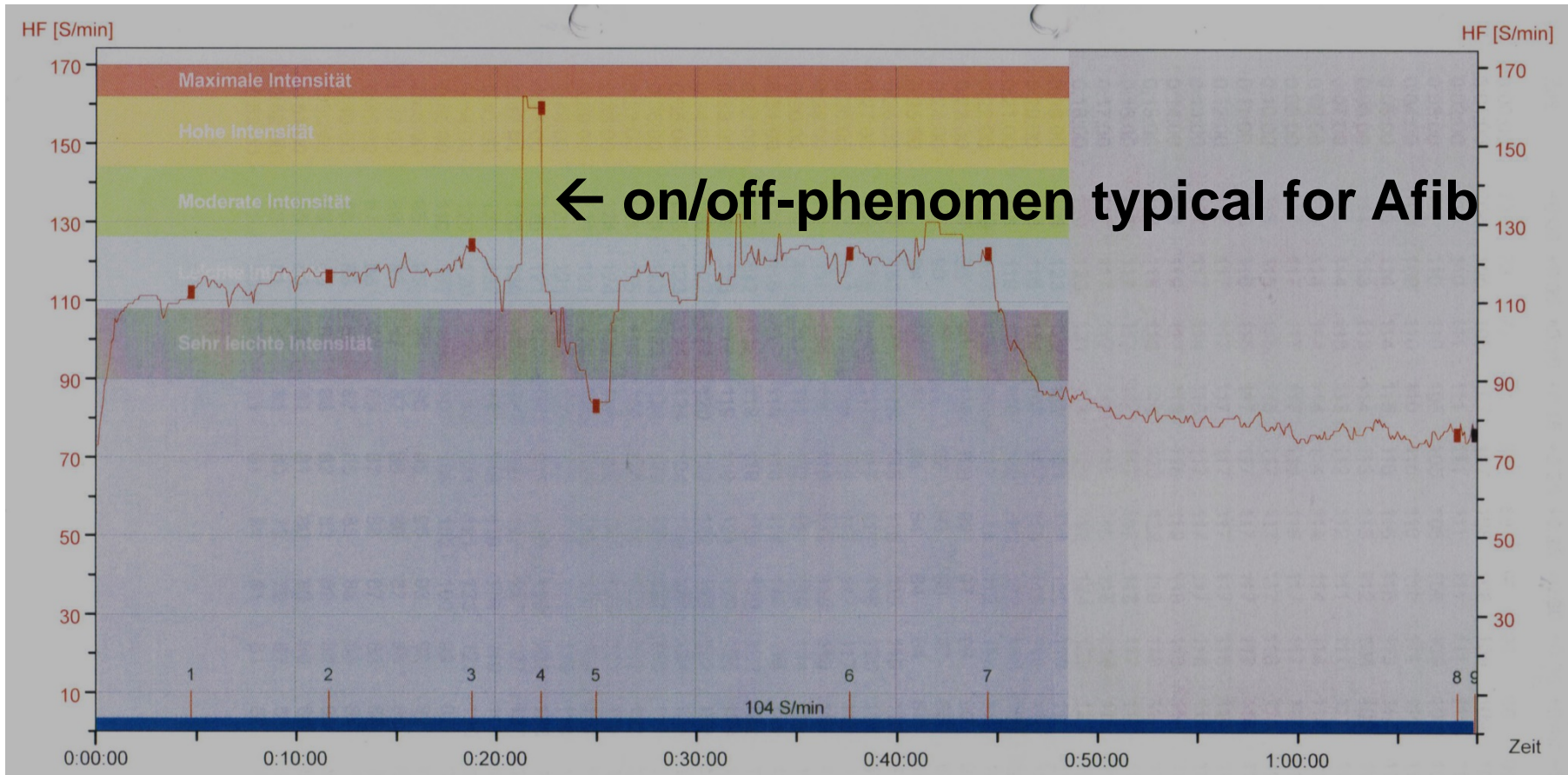
An LED shines a constant green light onto the skin. Some of it is reflected and scattered back into the photodiode. The amount of light that reaches the photodiode changes due to the pulse-wave and produces the PPG-curve:



The OHR tracks the time between pulses and thereby calculates the heart rate.



# Optical heart rate tracking in a runner (Sp. Björn., 56y.)



# Fitness trackers – what else can they measure ?

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e.g. by:  
Fitbit,  
Garmin,  
Polar,  
Apple...

## Technology

## parameters

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Accelerometer

physical activity, steps, floors, sleeping  
→ energy consumption

GPS signal

distance, location

Skin electrodes

ecg, emg, eeg, hrv

Pulse oxymeter

oxygen saturation



# Fitness trackers

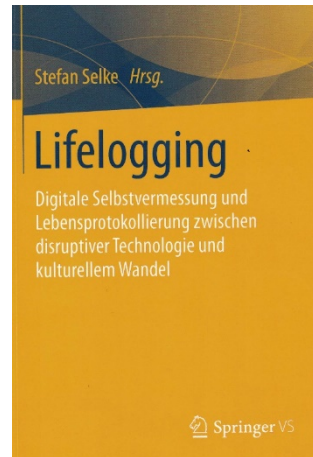
## Conclusion: a double-edged sword

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### boon:

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- Data for the GP
- Promote increase in physical activity
- Motivation to lose weight
- Exercise guidance



### bane:

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- „normal“ values
- Self logging
- Peergroup pressure
- Glass human being
- Human tracking
- data security

→ 1/3 stop the use within six months\*

\*) Chiauzzi E et al: *BMC Med.* 2015; 13; 77, doi: 10.1186/s12916-015-0319-2



# TIME

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 ESTONIA... \$4.99  
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## Never Offline.

The Apple Watch is just the start. How wearable tech will change your life—like it or not

BY LEV GROSSMAN AND MATT VELLA

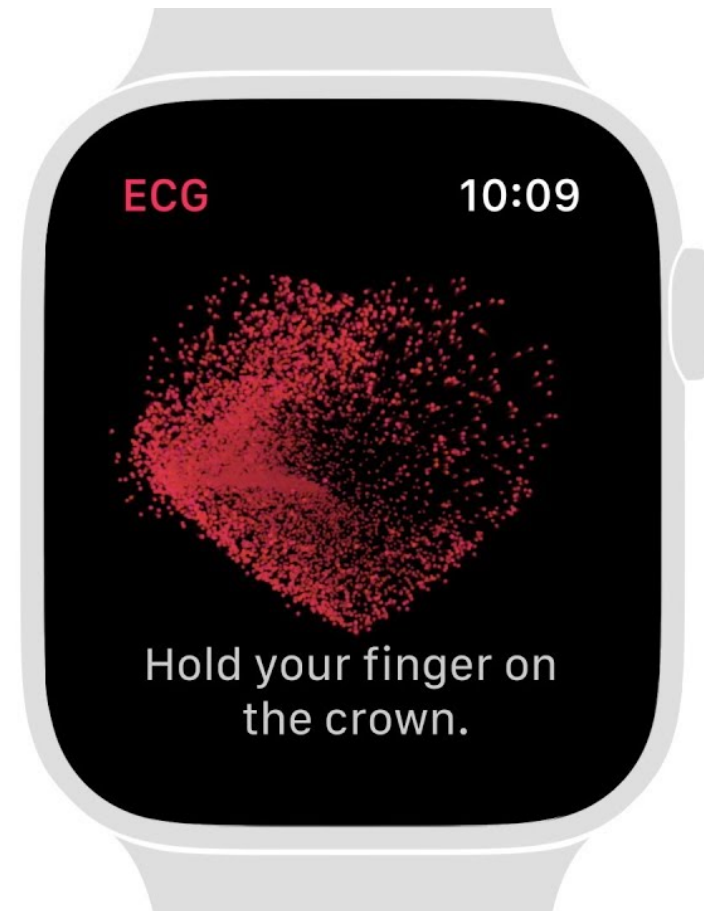


# From fitness trackers to smart watches

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## 2019: How to take an ECG

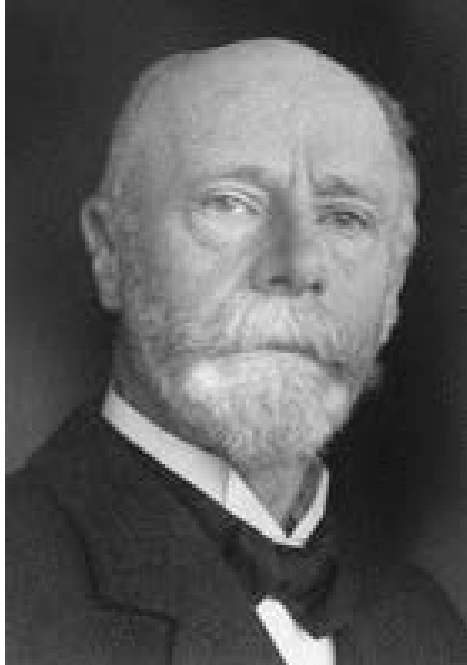
Apple WATCH





# ECG – this man invented it 126 years ago:

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**Willem Einthoven**

**\* May 21<sup>st</sup> 1860 (Java)**

**† Sept. 28<sup>th</sup> 1927 (Leiden)**


**1893: Einthoven recorded the first – as he called it - ECG**

**1924: Nobel Prize in Medicine for the developing of the ECG**



# ECG – how it works

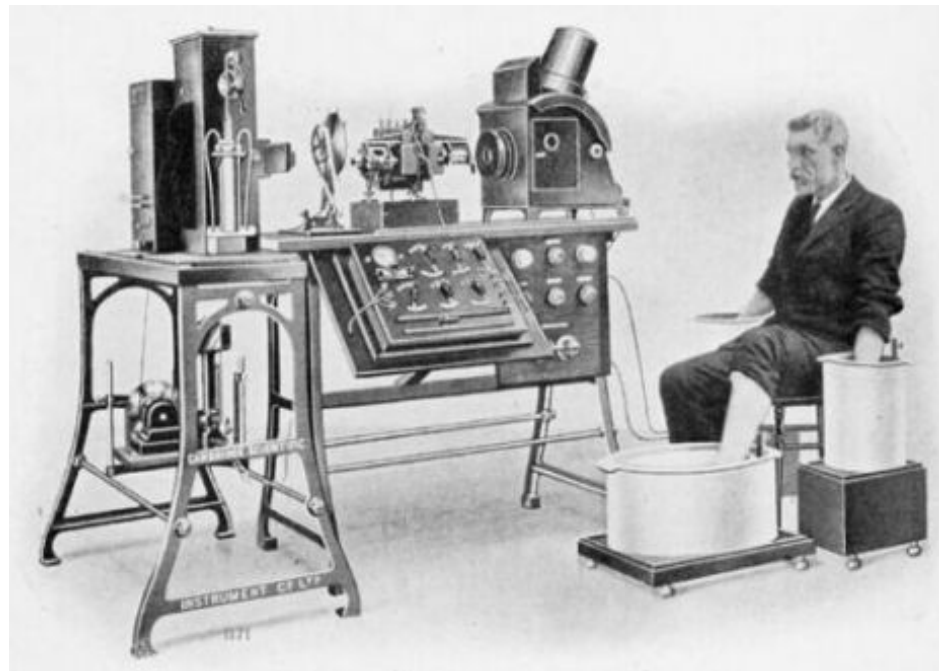
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An ECG records the electrical activity of the beating heart between two points to identify and localize pathologies by different leads.....

A lead refers to an imaginary line between two electrodes.

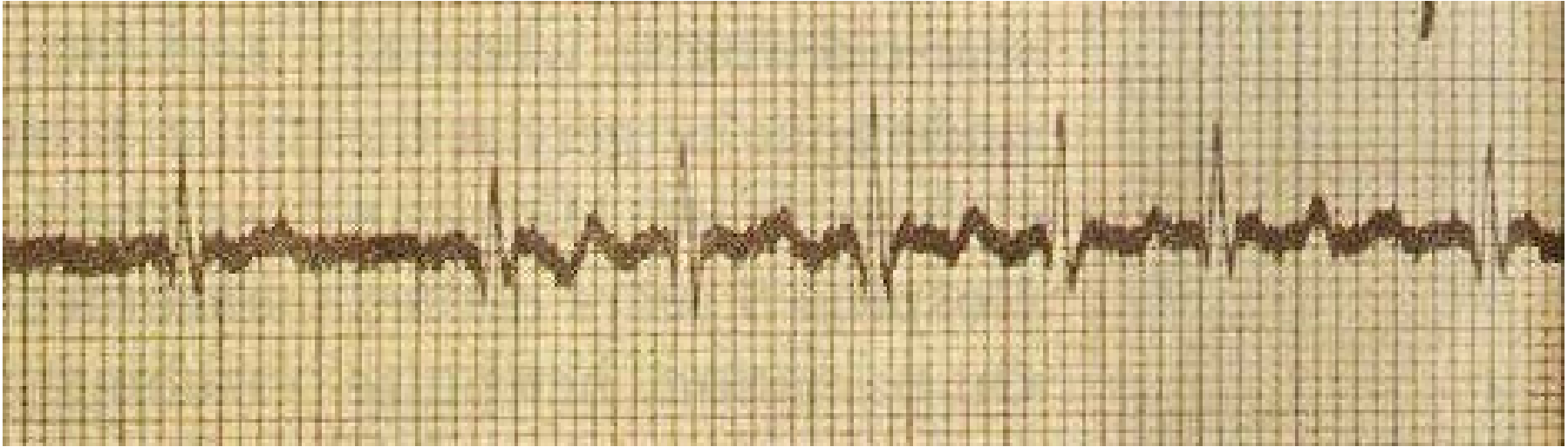


1893



# Atrial fibrillation – first description

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**„auricular fibrillation“ = atrial fibrillation**

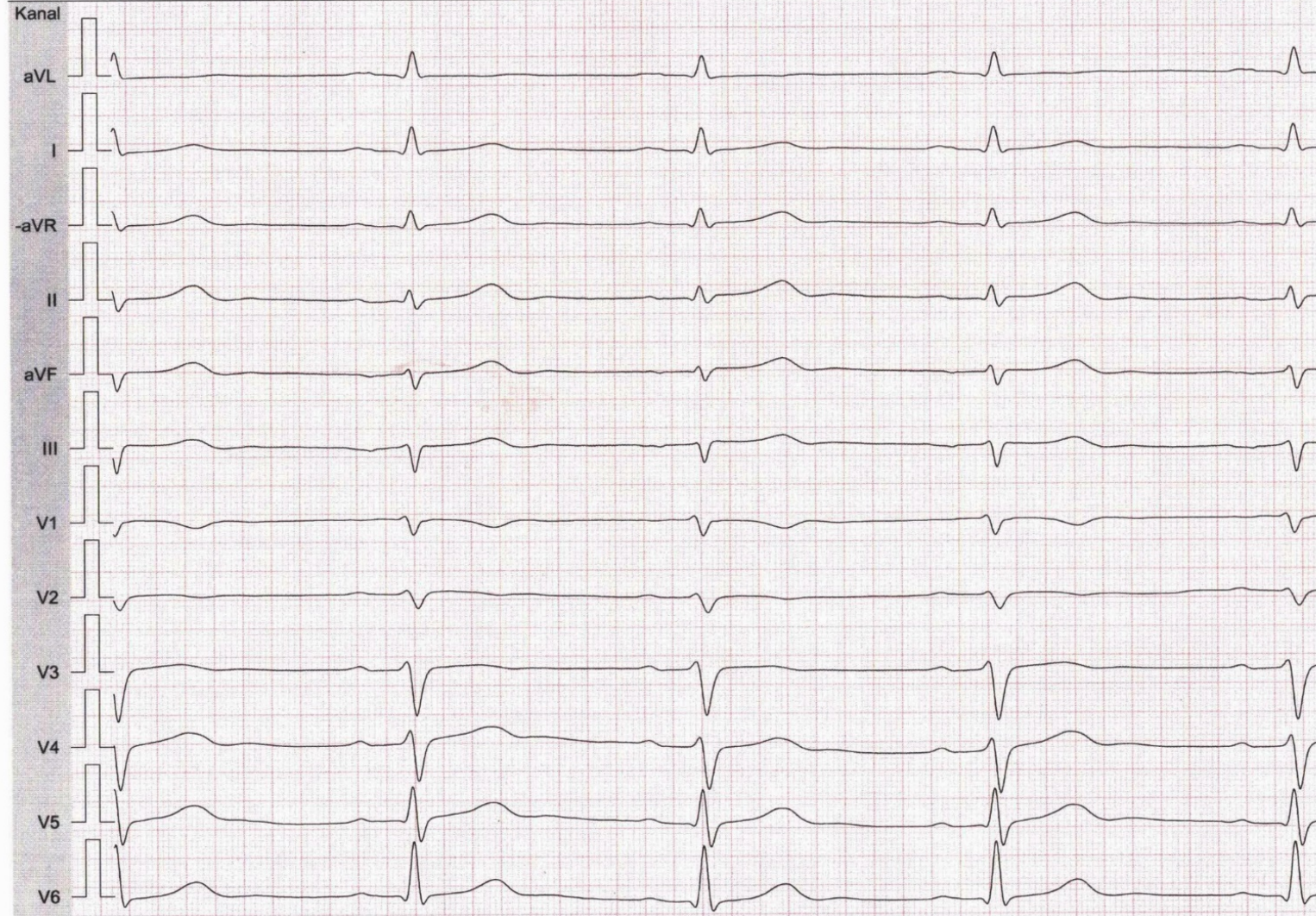
*Einthoven W. Le télécardiogramme. Arch Int Physiol 4: 132-164 (1906)*



# 12 lead-ECG

Analysiertes EKG HF: 59

(50 mm/s 10 mm/mV 0.05Hz - 45Hz / 50Hz true wave®)



# Resting 1 lead-ECG

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**1 lead ECG transmitted to an iphone  
and from there via pdf to the GP**

**Lead I between  
left wrist and  
right forefinger**



# 2019: three watches with ecg-function

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**Apple watch 4**

**available  
now**



**Samsung  
Galaxy  
Watch  
Active 2**

**available  
in october**



**Withings Move ECG**

**available  
now**



# Wendt Tom

Geburtsdatum: 10.03.1955 (Alter 64)

Aufgezeichnet am 24.05.2019 um 05:36

## Sinusrhythmus — ❤️ 54 BPM Ø

Dieses EKG weist keine Anzeichen von Vorhofflimmern auf.



# Werner J

Durchgeführt am Freitag, September 20 um 20:24 | 30 Sekunden lang | Linkes Handgelenk

♥ Mittelwert: 61 BPM





# K., Hans

Geburtsdatum: 25.01.1955 (Alter 64)

Aufgezeichnet am 02.09.2019 um 14:42

## Vorhofflimmern — ❤️ 102 BPM Ø

Dieses EKG deutet auf Vorhofflimmern hin.

Wenn du dieses Ergebnis nicht erwartet hast, solltest du mit deinem Arzt sprechen.



# Atrial fibrillation – epidemiological data

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- 1 to 3% of the population = 2 Mio. in Germany
- being 40: every 4th in his/her residual lifetime\*
- Population of 80+: 10% prevalence
- increasing numbers in the future
- estimated number of undetected cases: 1 Mio.
  - in the early stage only short episodes of afib
  - many patients are asymptomatic



# Causes of Afib

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- **Diseases of the heart, e.g.:**
  - **valvular heart disease**
  - **Hypertension**
  - **myocardial infarction**
  - **myocarditis**
- **Thyroid hyperfunction**
- **Diabetes**
- **Genetical predisposition**
- **Age**
- **Totally healthy, young people !!!!!**
- **Tall people**
- **Former marathon runners**



# Possible late sequela of endurance sports

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**10-fold Afib risk !**

***Mont et al,  
Euorapace 2009;  
11 (1): 11 - 17***



# Afib – exceptional characteristics (1)

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- **most common arrhythmia worldwide**
- **often asymptomatic**
- **in the early stage only short episodes of afib (< 1h)**
- **in many cases Afib-patients are young and healthy**
- **25% of all strokes are caused by Afib.**
- **in 25% of the Afib-patients the 1st symptom is a stroke**
- **repetitive SCIs seem to be a risk factor for dementia**



# Repetitive SCIs seem to be a risk factor for dementia

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# JACC

JOURNAL of the AMERICAN COLLEGE of CARDIOLOGY

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[Volume 62, Issue 21, November 2013 >](#)

**Clinical Research:** Heart Rhythm Disorders: Editorial Comment | November 2013

## Atrial Fibrillation, Silent Cerebral Ischemia, and Cognitive Function\*

FREE

Steven Shea, MD<sup>†</sup>; Marco Di Tullio, MD<sup>†</sup>

[\[+\] Author Information](#)

*J Am Coll Cardiol.* 2013;62(21):1998-1999. doi:10.1016/j.jacc.2013.06.025



# **Afib – exceptional characteristics (2)**

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- **Afib can be cured by PVI**
- **Strokes because of Afib can be prevented by DOACs**

**But only under the premise that Afib is detected =  
documented with an ECG over 30 seconds**



H., Lydia

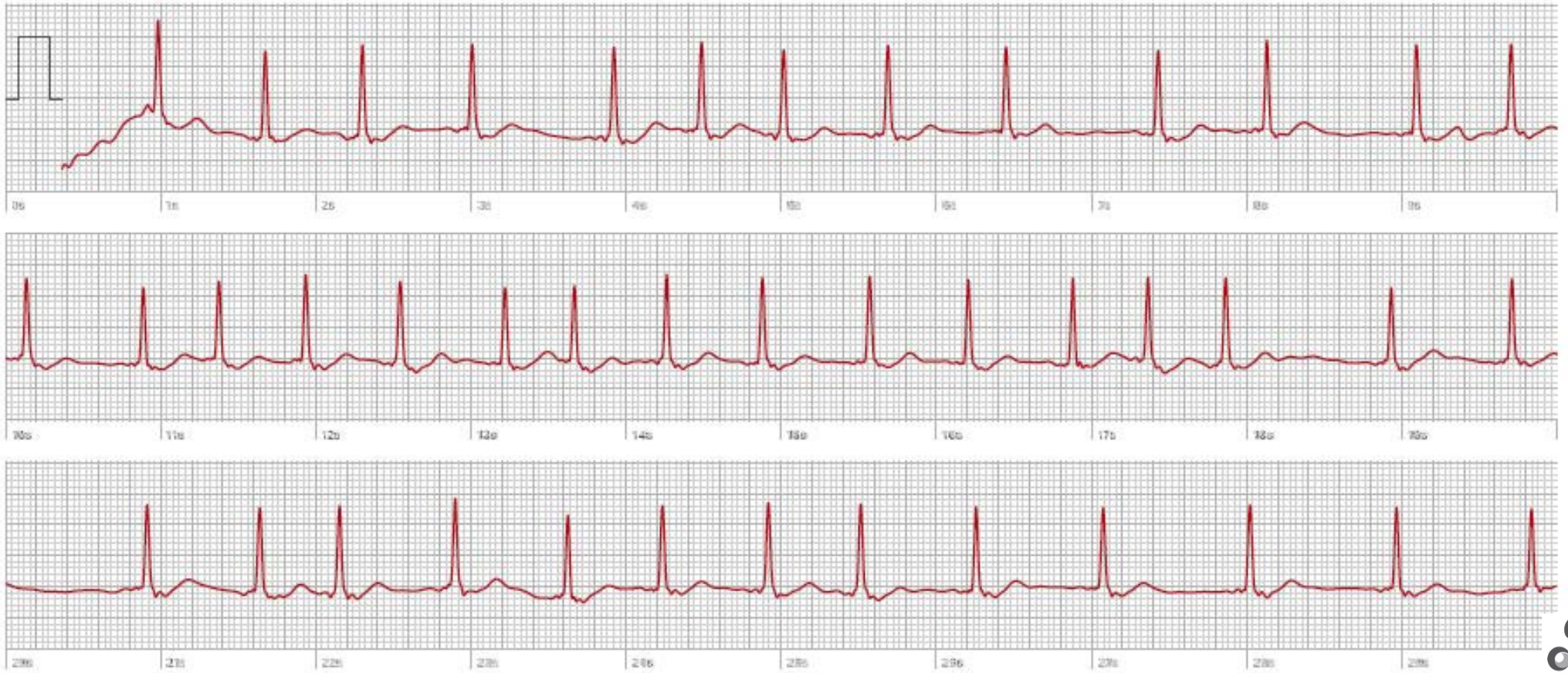
Geburtsdatum: 11.06.41 (Alter 78)

Aufgezeichnet am 02.09.2019 um 15:07

**Vorhofflimmern — ❤️ 85 BPM Ø**

Dieses EKG deutet auf Vorhofflimmern hin.

Wenn du dieses Ergebnis nicht erwartet hast, solltest du mit deinem Arzt sprechen.





# H., Julian

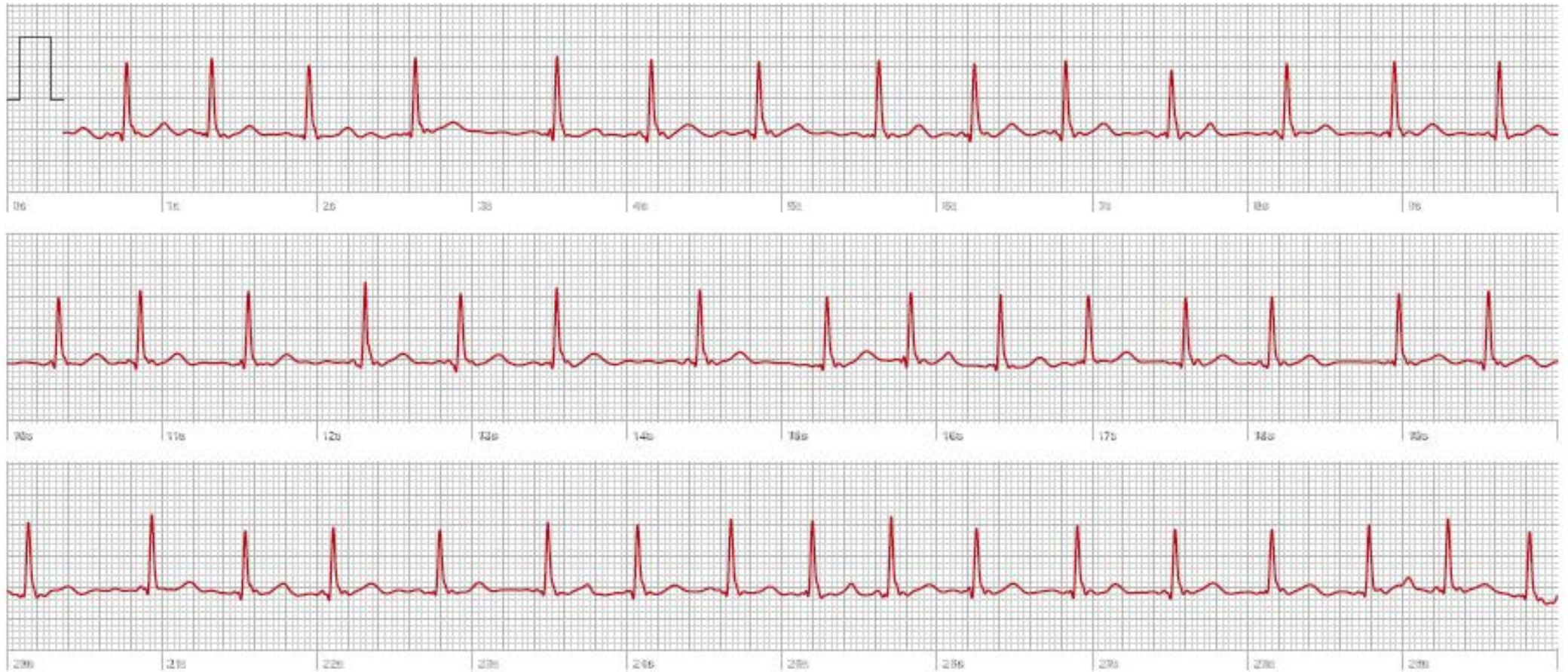
Geburtsdatum: 12.05.77 (Alter 42)

Aufgezeichnet am 25.07.2019 um 17:37

## Vorhofflimmern — ❤️ 92 BPM Ø

Dieses EKG deutet auf Vorhofflimmern hin.

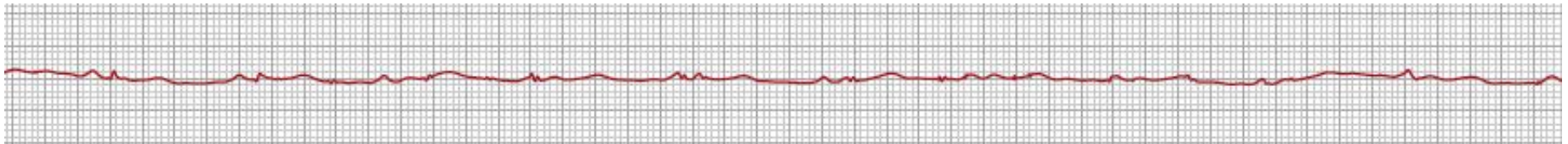
Wenn du dieses Ergebnis nicht erwartet hast, solltest du mit deinem Arzt sprechen.



# **(Smart) watches with ecg-function - limitations**

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- **Price (apple 300 to 500 €, withings 130 €, Samsung ?)**
- **Technical skills of the user ?**
- **Myocardial infarction cannot be identified !!!**
- **Recording can happen only if afib is symptomatic.**
- **Not possible in arm-amputated patients.**
- **Tiny recordings in patients with right axis deviation**



# **(Smart) watches with ecg-function**

## **Conclusion: a double-edged sword**

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### **boon:**

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- **Early detection of Afib**
- **Documentation of Afib**
- **Saving of Holter ecgs**
- **Prevention of stroke (!)  
and dementia (?)  
(individual and society)**

### **bane:**

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- **In hypochondriac persons their fears may be amplified**
- **An avalanche of self recorded ecgs overruns GPs in the US**
- **Reliability of the Afib-algorithm**
- **Responsibility of immediate therapeutic consequences**
- **Adequate payment**

**Total of strokes in FRG/year:  
270000  
25% = 67500**

