

Μηχανισμός πρόκλησης και επιδημιολογικά δεδομένα αιφνίδιου καρδιακού θανάτου



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SUDDEN CARDIAC DEATH

Sudden cardiac death is defined as the ***unexpected*** death due to a cardiac cause, in patient with or without cardiac disease, which occurs ***within one hour*** from the appearance of the ***first*** clinical symptoms.



European Society
of Cardiology

European Heart Journal (2022) **43**, 3997–4126
<https://doi.org/10.1093/eurheartj/ehac262>

ESC GUIDELINES

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

SUDDEN CARDIAC DEATH

Sudden natural death presumed to be of cardiac cause that occurs within 1 h of onset of symptoms in witnessed cases, and within 24 h of last being seen alive when it is unwitnessed.

SUDDEN CARDIAC DEATH

Epidemiology

Geography	Frequency	Survival
Globally	3,000,000	<1%
USA	~450,000	~5%
Europe	~300,000	<5%

Determinants of occurrence and survival after sudden cardiac arrest—A European perspective: The ESCAPE-NET project[☆]

Jean-Philippe Empana^a, Marieke T. Blom^b, Bernd W. Böttiger^{c,n}, Nikolaos Dargès^d,
Jacqueline M. Dekker^e, Gunnar Gislason^f, Xavier Jouven^a, Thomas Meitinger^g,
Giuseppe Ristagno^{h,i}, Peter J. Schwartz^j, Martin Jonsson^k, Jacob Tfelt-Hansen^m,
Anatolij Truhlar^l, Hanno L. Tan^{b,*}, on behalf of the ESCAPE-NET Investigators²

Incidence of Sudden Cardiac Death in the European Union



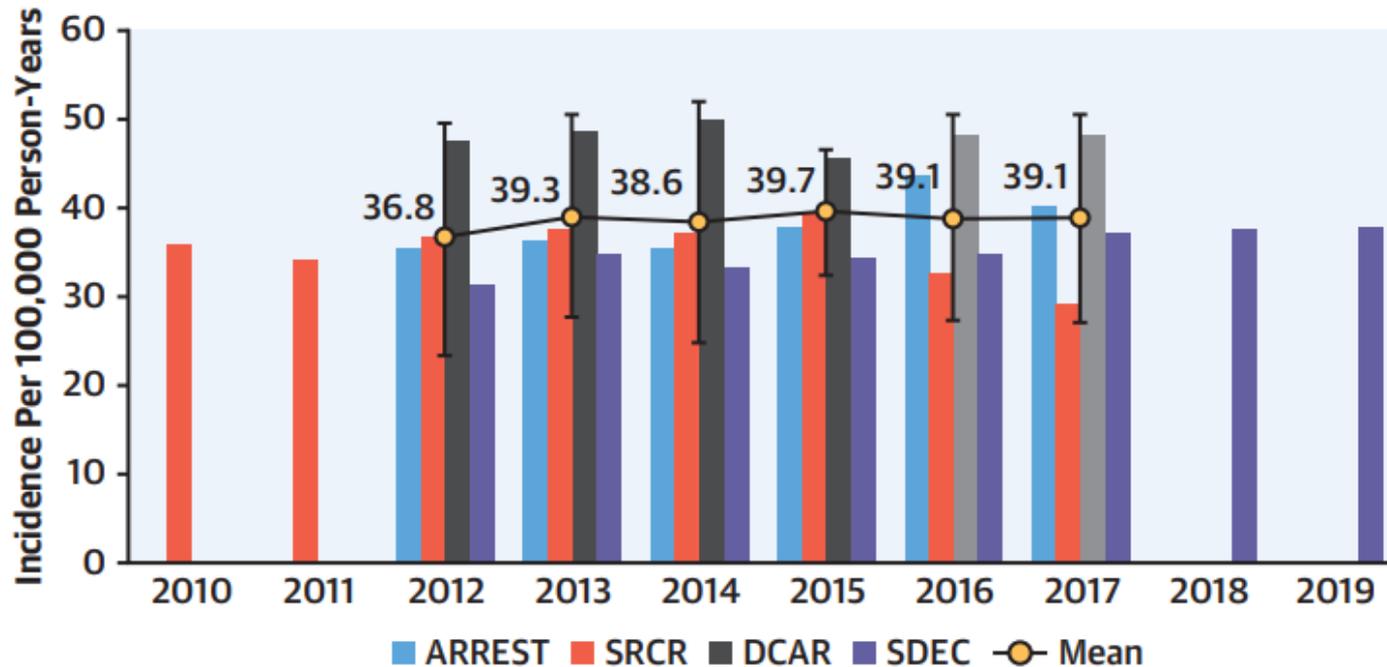
TABLE 1 Characteristics of the 4 Registries

Registry	Geographic Area	Population (Coverage %)	Years	OHCA Definition ^a	SCD Definition
SDEC	Paris and its suburbs, France	6.8 million (10.1)	2012-2019	EMS- or bystander-attended or unattended	Utstein on the basis of EMS records and hospital records
SRCR	Stockholm region, Sweden	2.2 million (23.6)	2010-2017	EMS- or bystander-attended or unattended	Utstein on the basis of EMS records and hospital records
DCAR	Denmark	5.8 million (100)	2012-2017	EMS- or bystander-attended with exclusion of deceased on arrival	Utstein on the basis of EMS records and hospital records
ARREST	North Holland, the Netherlands	2.4 million (16.3)	2012-2017	EMS-attended or bystander AED-treated with ROSC at EMS arrival	Utstein on the basis of EMS and patient interview, general practitioner database, hospital records

Incidence of Sudden Cardiac Death in the European Union



CENTRAL ILLUSTRATION Trends in the Incidence of Sudden Cardiac Death

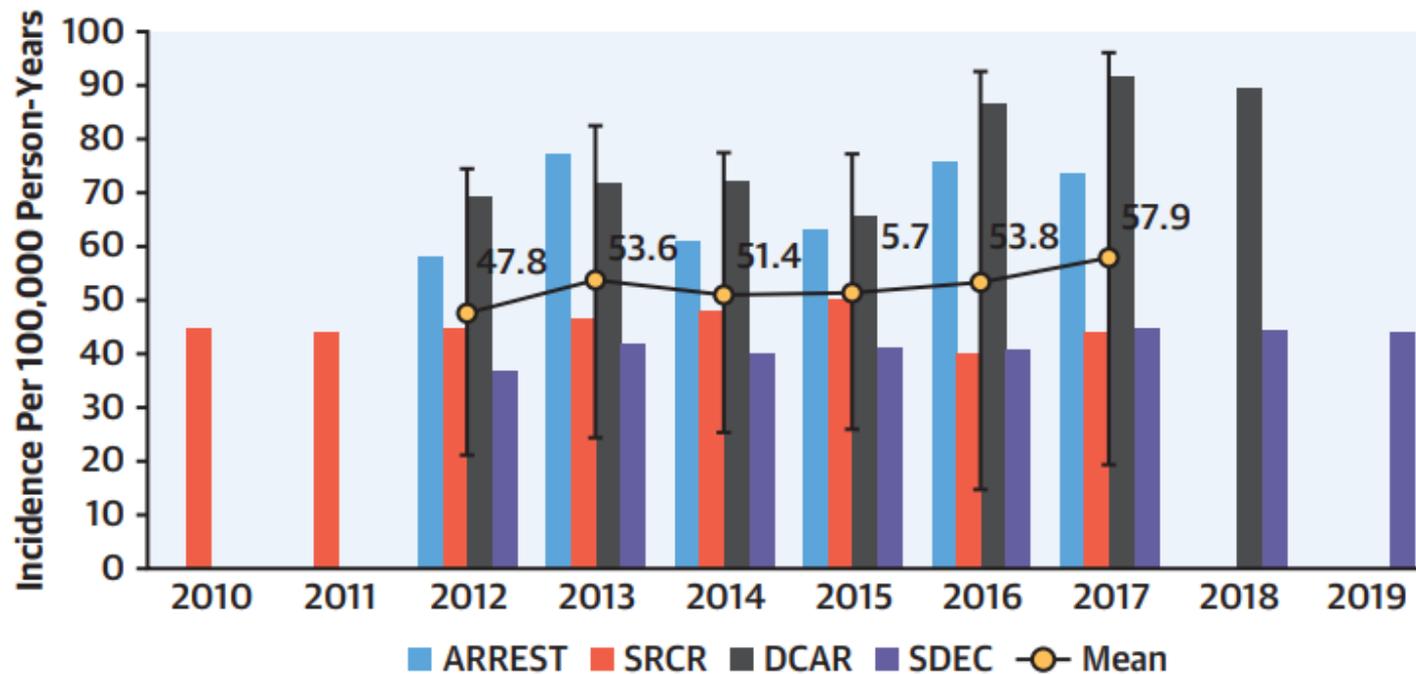


Empana J-P, et al. *J Am Coll Cardiol.* 2022;79(18):1818-1827.

Incidence of Sudden Cardiac Death in the European Union



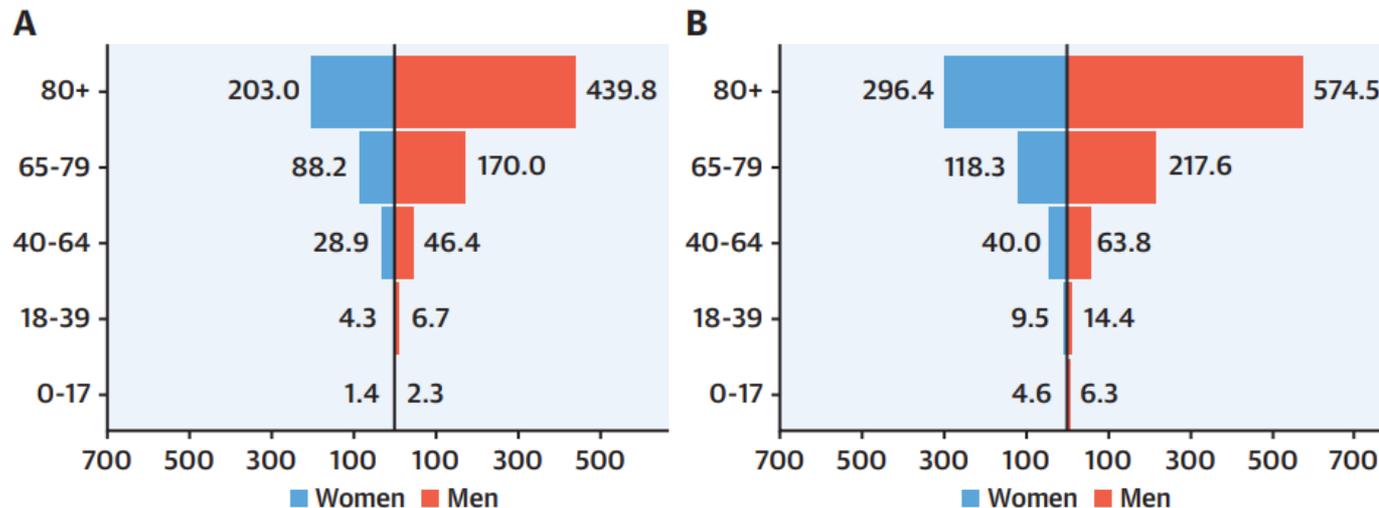
FIGURE 1 Trends in the Incidence of EMS-Attended OHCA



Incidence of Sudden Cardiac Death in the European Union



FIGURE 2 Incidence Rates of SCD and OHCA by Age and Sex



Incidence Rate Ratio Men vs Women		
Age group	OHCA	SCD
0-17	1.37	1.65
18-39	1.51	1.56
40-64	1.60	1.61
65-79	1.84	1.93
80+	1.94	2.17

Incidence of Sudden Cardiac Death in the European Union



TABLE 2 Main Clinical Characteristics and Circumstances Surrounding OHCA Across the 4 Registries

	ARREST (n = 5,825)	SDEC (n = 14,581)	SRCR (n = 6,346)	DCAR (n = 15,238)
Female	29.2	35.3	34.3	36.6
Age	68.0 (59.0-78.0)	68.5 (55.6-81.4)	71.0 (59.0-81.0)	72.0 (61.0-82.0)
OHCA in nonpublic place	73.2	75.5	66.8	73.3
OHCA in public place	26.8	24.5	33.2	26.7
Witnessed OHCA	71.9	79.2	–	43.3
Bystander CPR performed	76.0	71.7	51.2	66.4
Bystander AED used	10.6	3.2	2.3	3.2
VT-VF as first recorded rhythm	42.2	26.7	20.5	20.4
Median time between dispatch call and ambulance arrival, min	8.5 (6.6-10.8)	9.0 (7.0-12.0)	9.0 (6.0-13.0)	–
ROSC	41.8	40.7	33.2	29.2
Transferred to hospital alive	59.6	30.7	60.4	36.3

Values are % or median (IQR).

CPR = cardiopulmonary resuscitation; VF = ventricular fibrillation; VT = ventricular tachycardia; other abbreviations as in [Table 1](#).

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Recommendation Table 1 — Recommendations for public basic life support and access to automated external defibrillators

Recommendations	Class ^a	Level ^b
It is recommended that public access defibrillation be available at sites where cardiac arrest is more likely to occur. ^{c,90–92}	I	B
Prompt CPR by bystanders is recommended at OHCA. ^{93–95}	I	B
It is recommended to promote community training in basic life support to increase bystander CPR rate and AED use. ^{93,97,104}	I	B
Mobile phone-based alerting of basic life support-trained bystander volunteers to assist nearby OHCA victims should be considered. ^{101–103,105}	IIa	B

Incidence of Sudden Cardiac Death in the European Union



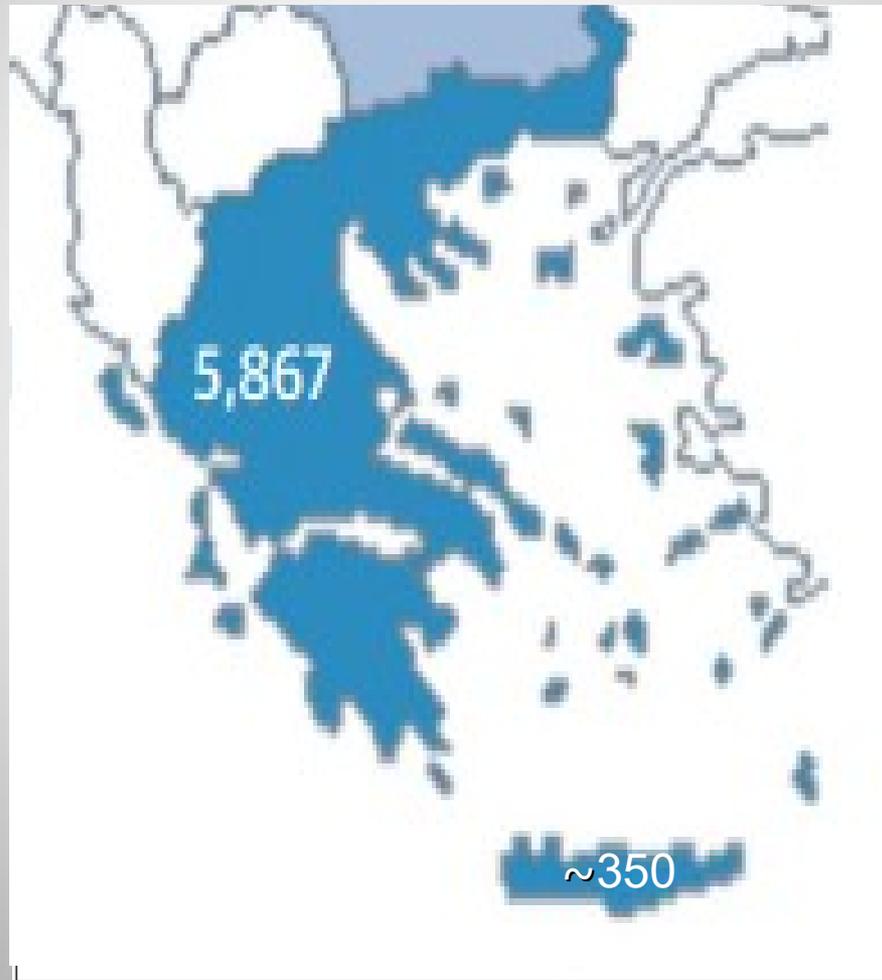
- ❑ **The findings suggest that at least, 249,538 SCD and 343,496 OHCA cases are expected each year in the European Union.**
- ❑ **Remarkably, the incidence of SCD did not show any significant variations across years and centers.**

Incidence of Sudden Cardiac Death in the European Union



- ❑ **Given the decrease in the age standardized prevalence of cardiovascular disease in Western Europe, in part thanks to improvements in the control of CVD risk factors, one could have expected the incidence of SCD to decrease as well.**
- ❑ **The absence of such a trend in the present study supports the primary importance of identifying those individuals from the general population, where most SCDs occur, who are the most at risk of SCD.**

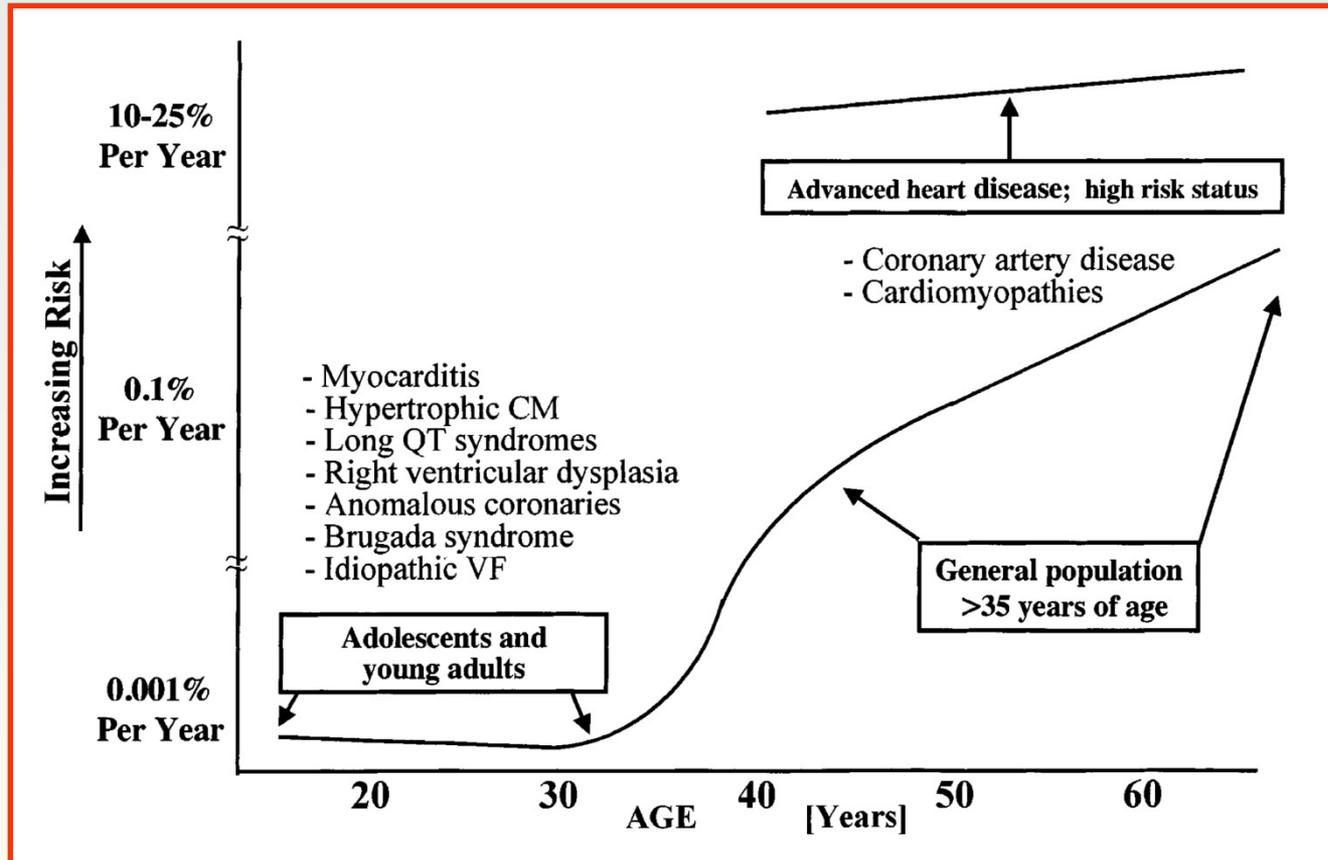
Incidence of Sudden Cardiac Death in the European Union



Οι προβληματισμοί

- **Ποιοι κινδυνεύουν?**
- **Πως θα ανιχνεύσουμε τους ασθενείς υψηλού κινδύνου?**
- **Πως μπορούμε να παρέμβουμε αποτελεσματικά?**

The magnitude of SCD risk



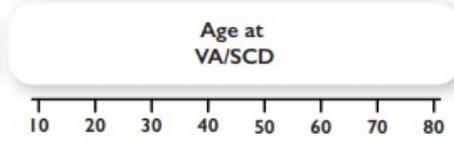
Age and cause-related

SUDDEN CARDIAC DEATH

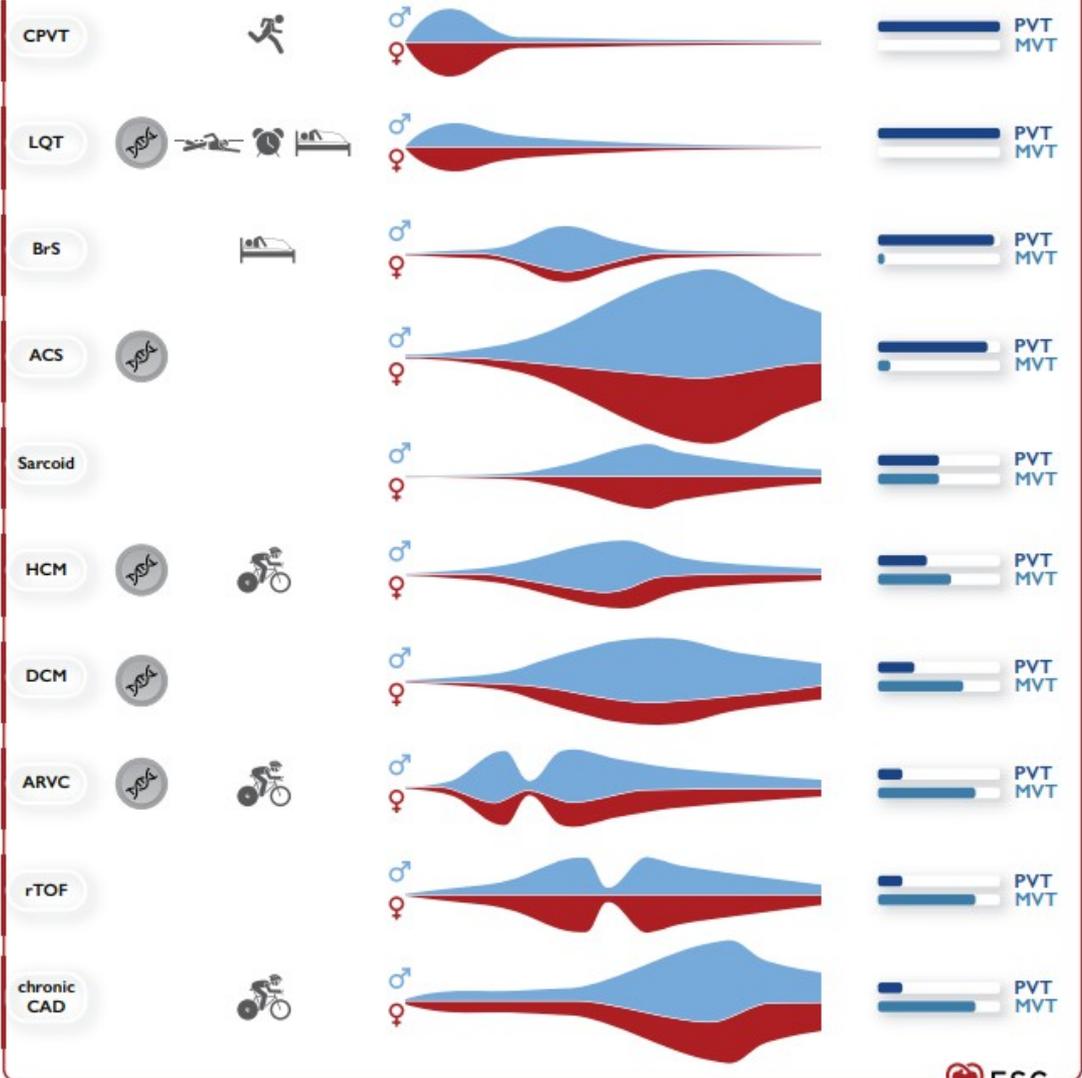
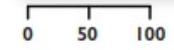
Epidemiology

- ❑ **The incidence of SCD increases markedly with age.**
- ❑ **With a very low incidence during **infancy and childhood** (**1 per 100 000 person years**)**
- ❑ **the incidence is approximately **50 per 100 000 person years in middle-aged individuals** (in the fifth to sixth decades of life).**
- ❑ **In the **eighth decade of life**, it reaches an annual incidence of at least **200 per 100 000 person-years**.**

Genetic risks and triggers for VA/SCD



Dominant subtype of VA (%)

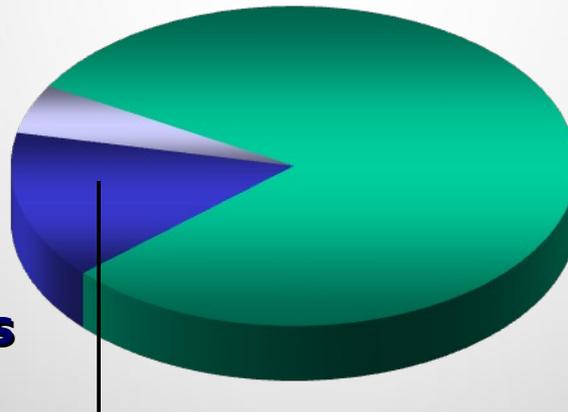


Επιδημιολογία του ΑΚΘ

- **80%** of SCDs results from **CAD**
- **SCD** accounts for approximately **~50%** of all cardiovascular deaths
- **30-50%** being the first manifestation of cardiac disease

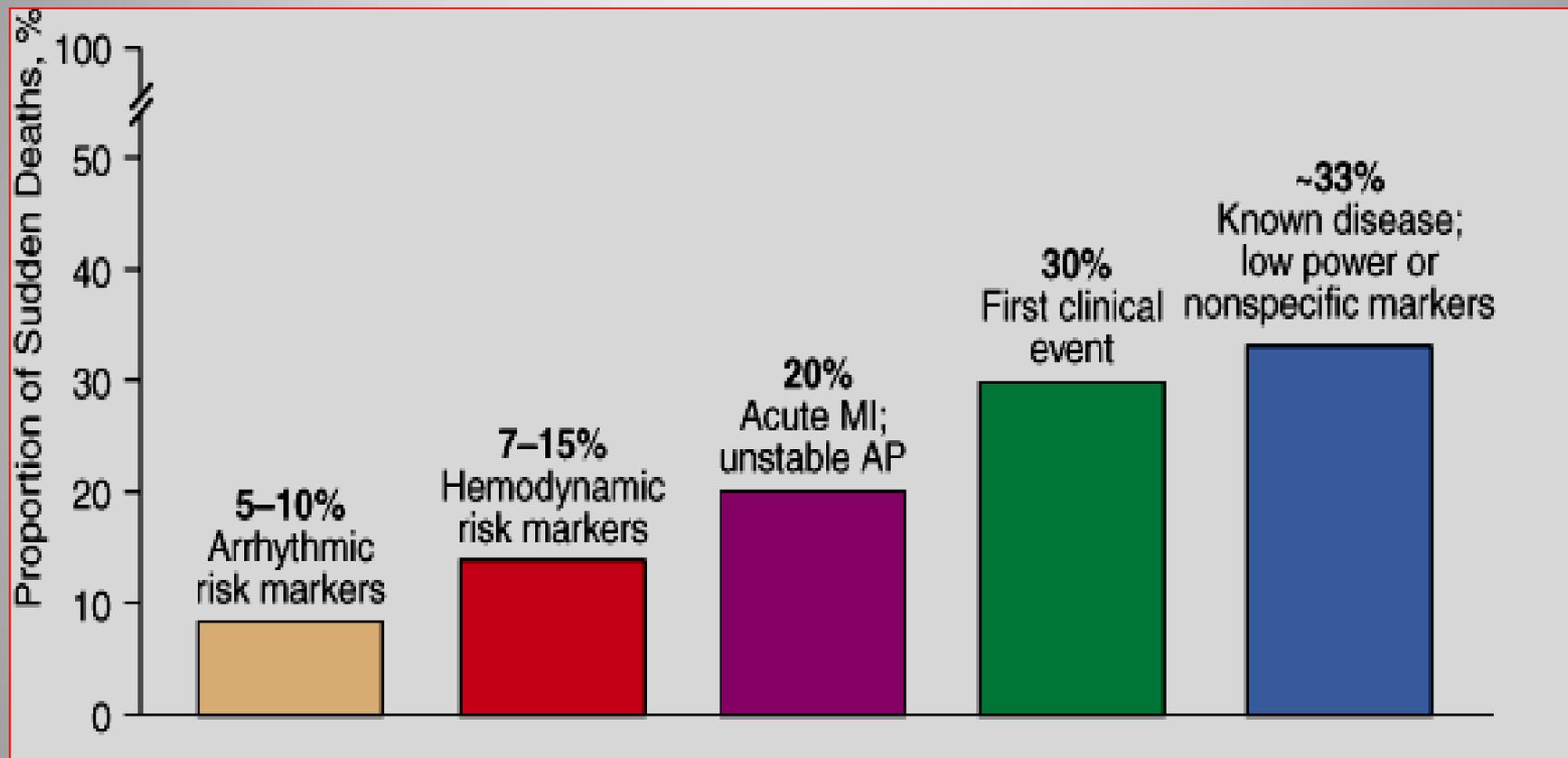
5% other*
* ion-channel abnormalities,
valvular or congenital heart
disease, other causes

15%
Cardiomyopathies

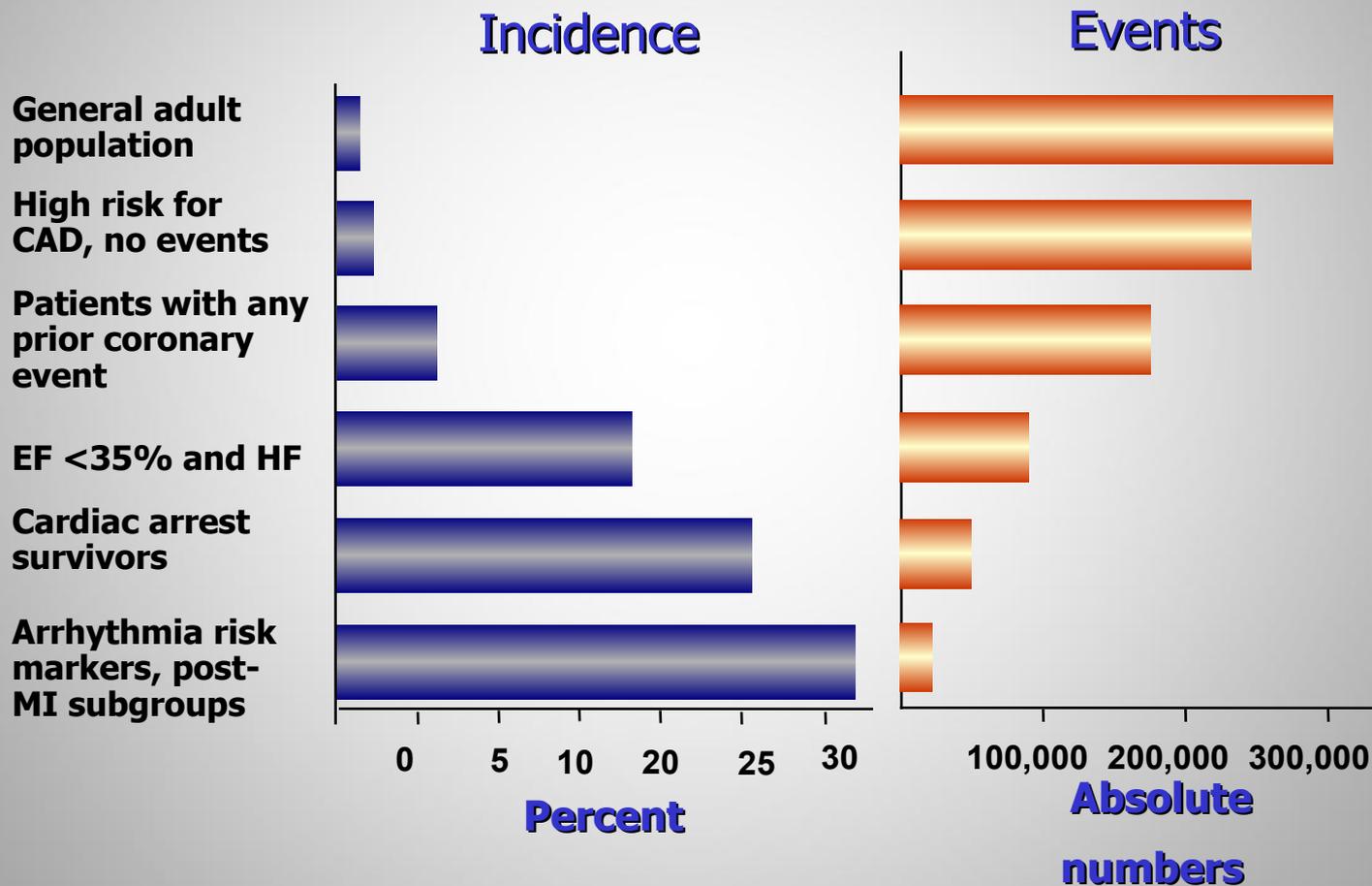


80%
**Coronary Artery
Disease**

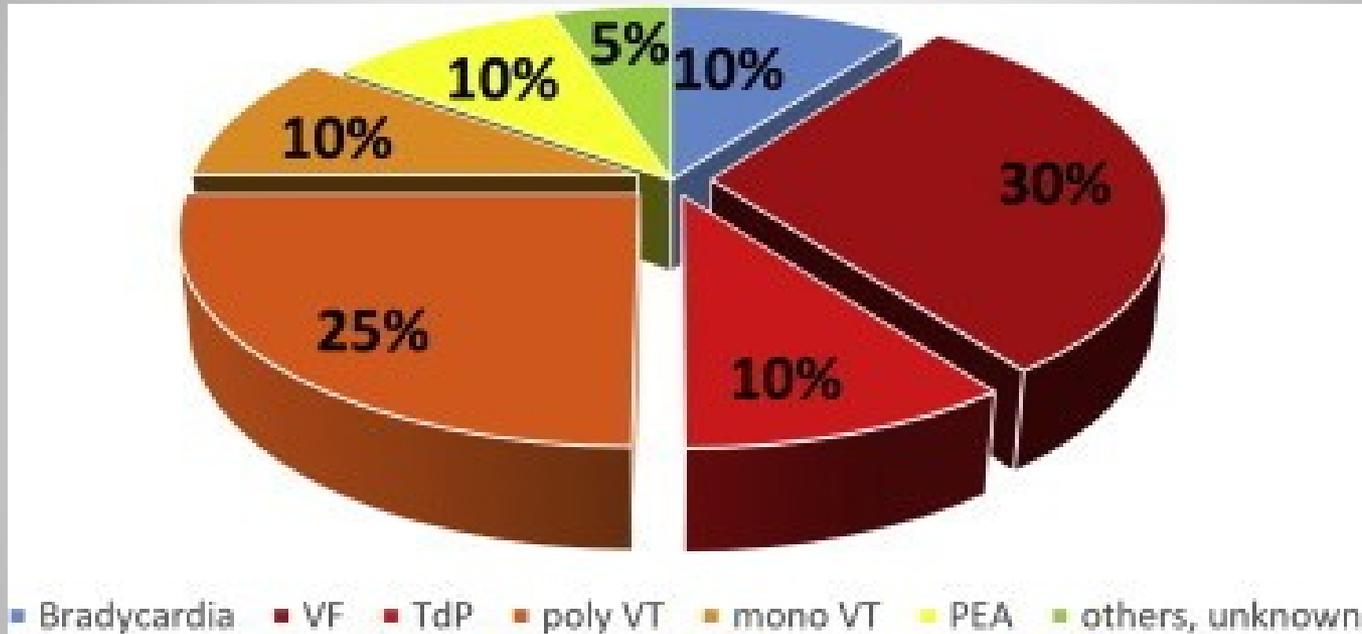
Σε ποιες συνθήκες συμβαίνει ο ΑΚΘ?



Επίπτωση & φορτίο ΑΚΘ



Arrhythmia documented as the first rhythm at out-of-hospital SCD



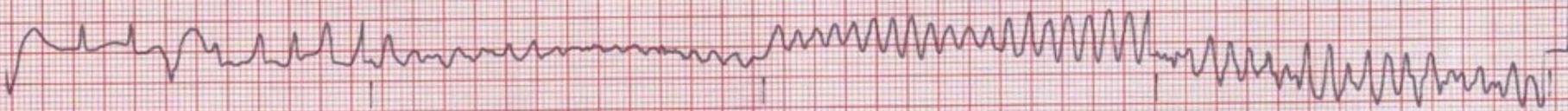
**Different forms of VT/VF taken together
(four red to orange slices) account for
75% of documented rhythms**

I

a/R

V1

V4

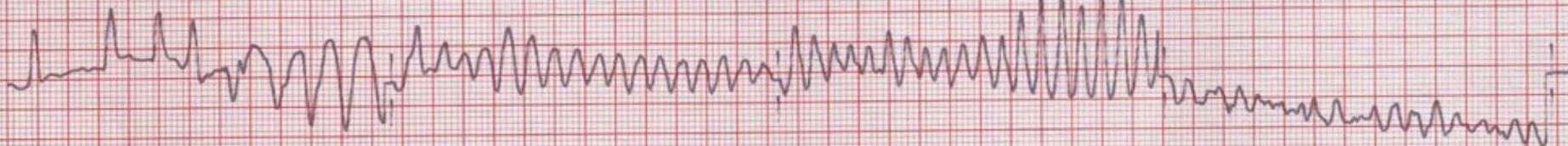


II

a/L

V2

V5



III

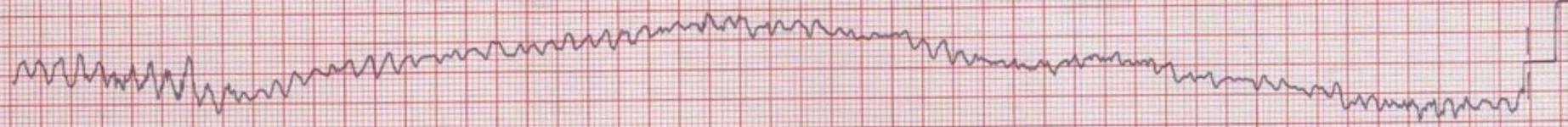
a/F

V3

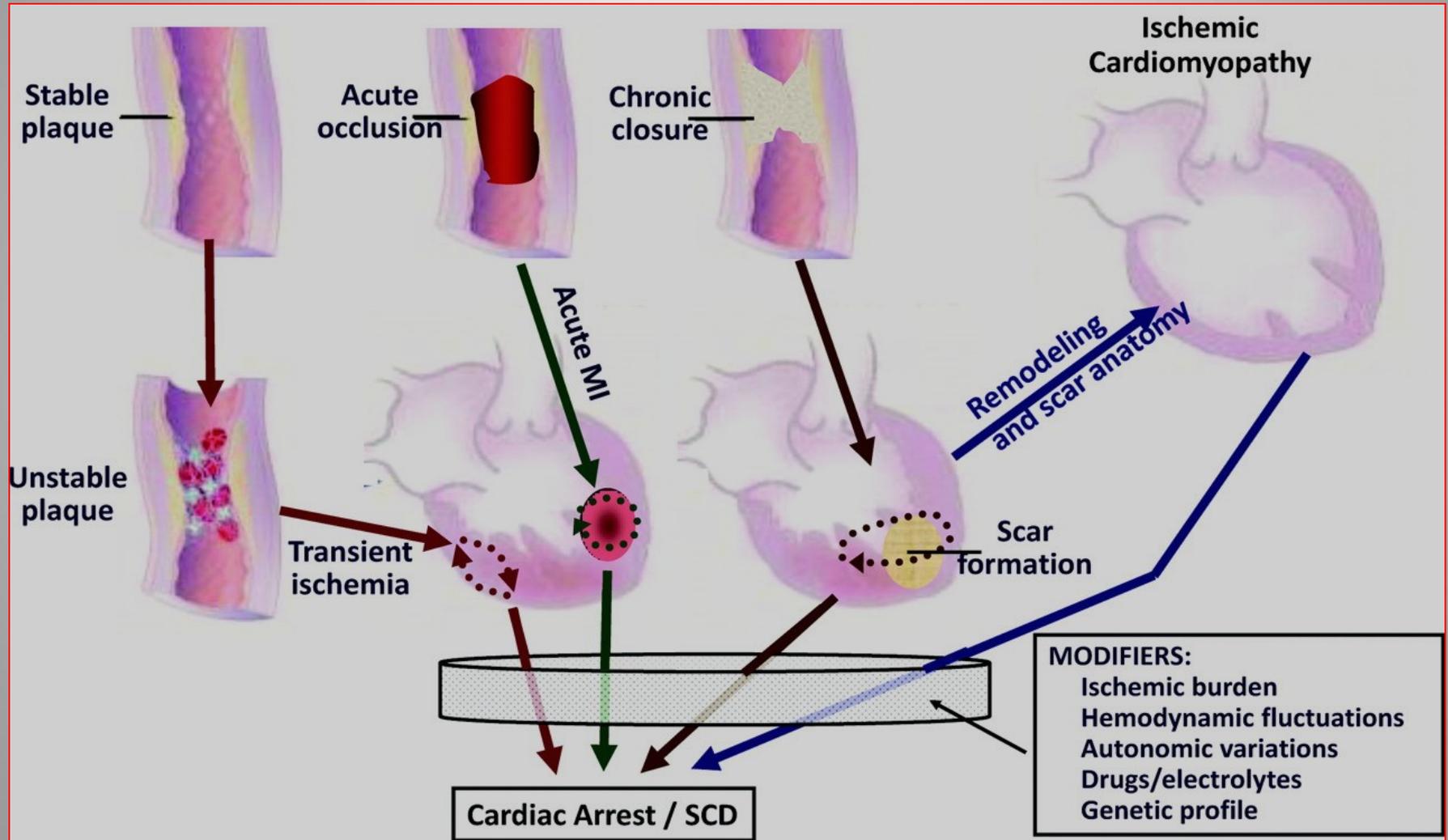
V6



RHYTHM STRIP: II
 25 mm/sec; 1 cm/mV



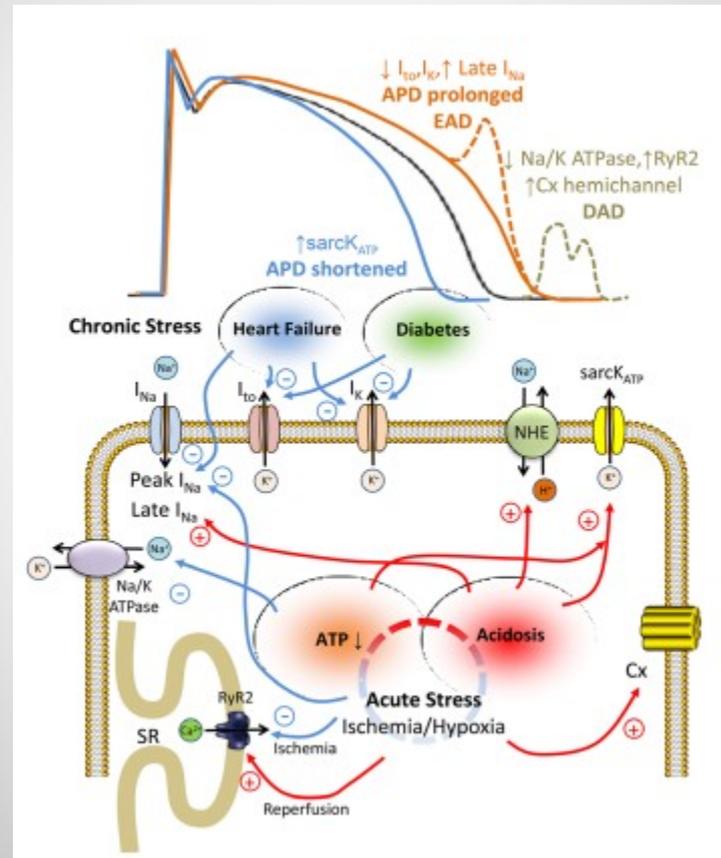
Η παθοφυσιολογία του ΑΚΘ



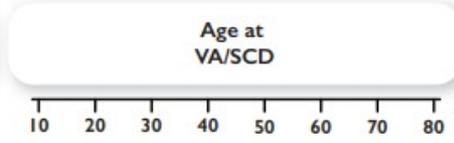
Mechanisms of Sudden Cardiac Death

Oxidants and Metabolism

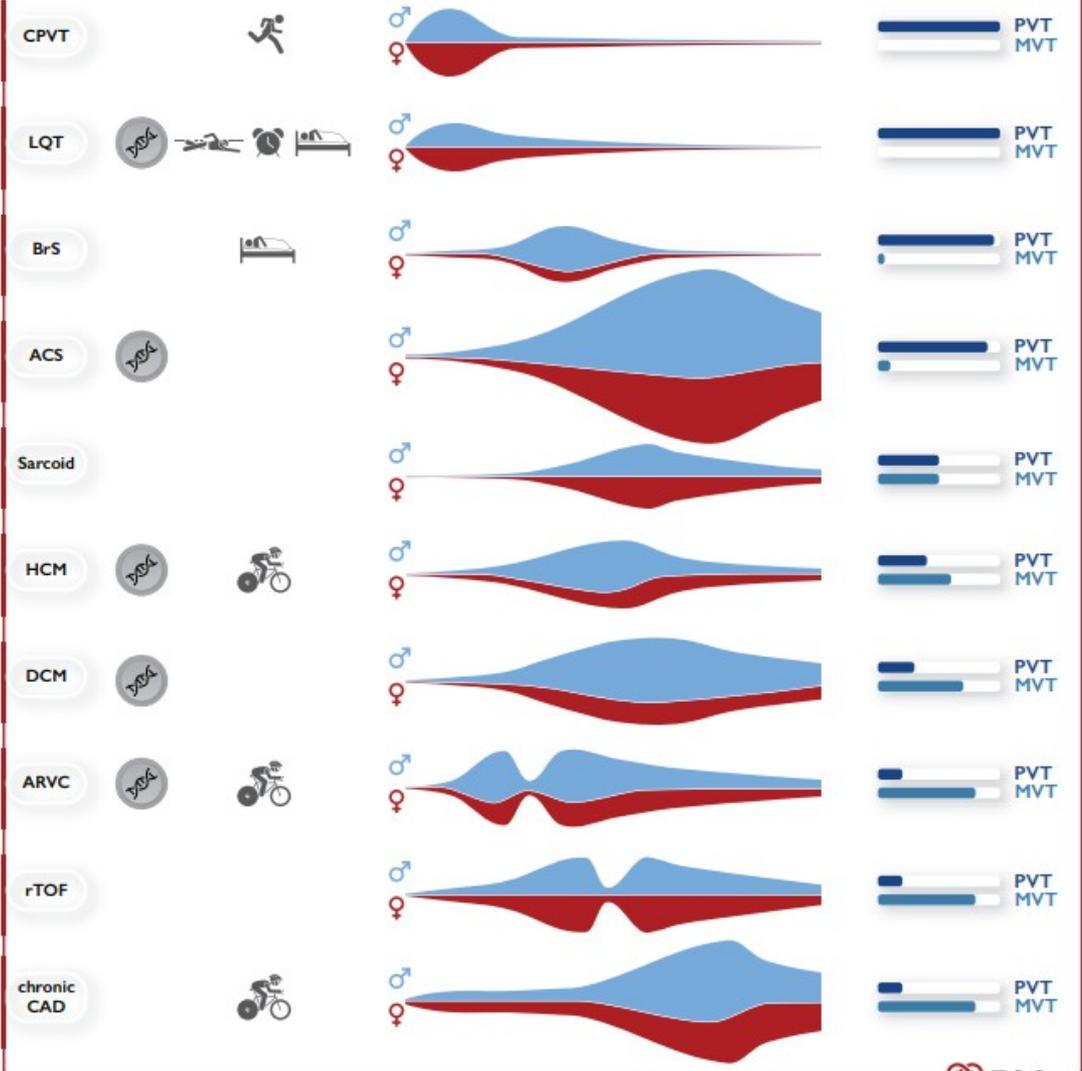
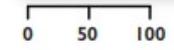
Kai-Chien Yang, John W. Kyle, Jonathan C. Makielski, Samuel C. Dudley Jr



Genetic risks and triggers for VA/SCD



Dominant subtype of VA (%)



SCD mechanisms

Table 1. Primary modes of cardiac arrest/SCD and mechanisms in selected disorders

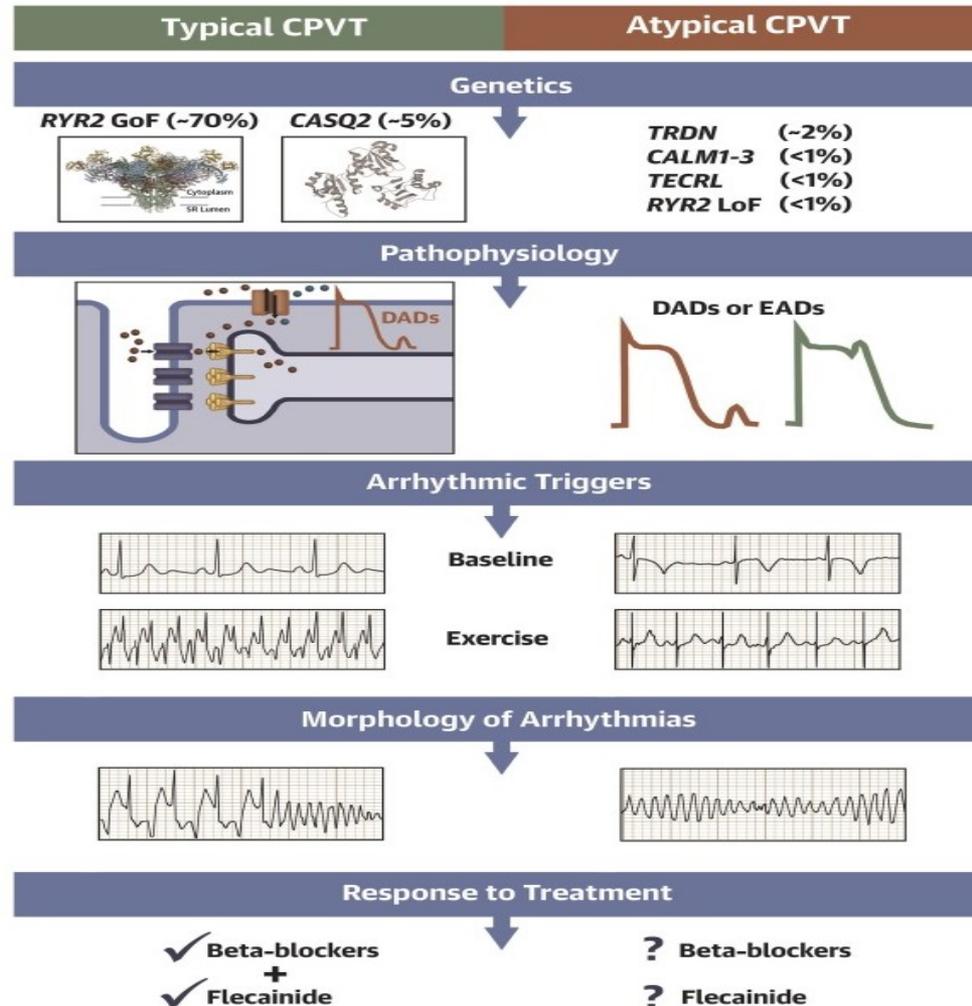
Disorder	Primary mode of cardiac arrest/SCD	Mechanism
Brugada syndrome	VT/VF	Reflection (phase 2 reentry)
CAD (Acute ischemia)	VT/VF	Multiple (reentry, automaticity, triggered activity)
CAD (Prior MI)	VT	Scar-mediated reentry
CPVT	VT/VF	Delayed after depolarizations
Dilated cardiomyopathy	VT	Scar-mediated reentry Bundle branch reentry
Hypertrophic cardiomyopathy	VT/VF	Multiple
Long QT syndrome	Torsades de pointes VT	Early after depolarizations
WPW syndrome	VF	Rapid conduction to the ventricles down an accessory pathway resulting in VF

CAD, coronary artery disease; MI, myocardial infarction; VT, ventricular tachycardia; VF, ventricular fibrillation; CPVT, catecholaminergic polymorphic ventricular tachycardia

SCD mechanism in CPVT

Incidence: 1/10000

CENTRAL ILLUSTRATION: Genetic, Pathophysiologic, Clinical and Therapeutic Differences Between Typical and Atypical Catecholaminergic Polymorphic Ventricular Tachycardia



SCD mechanism in Long QT

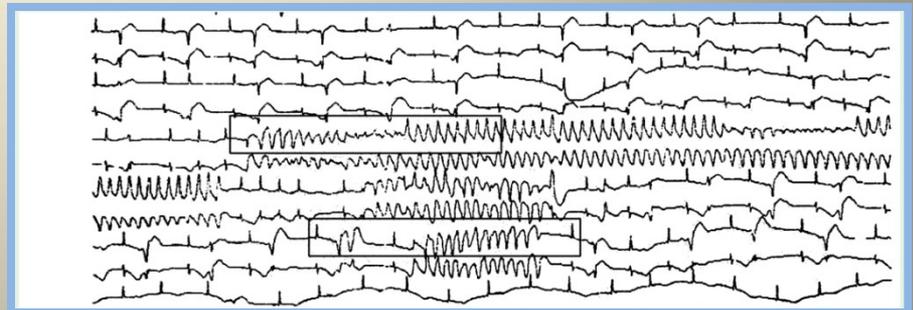
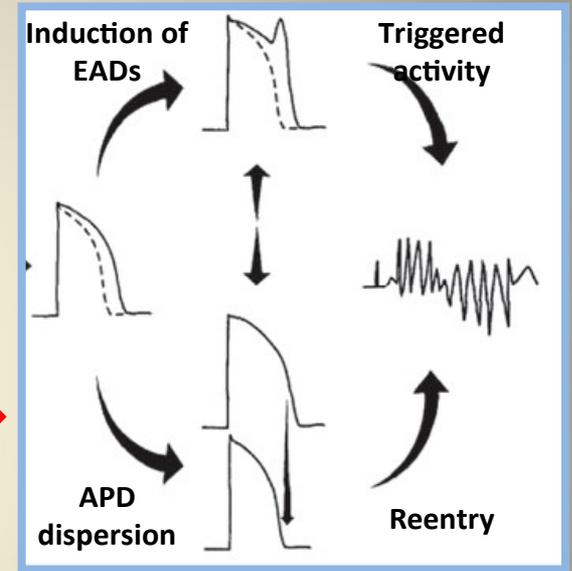
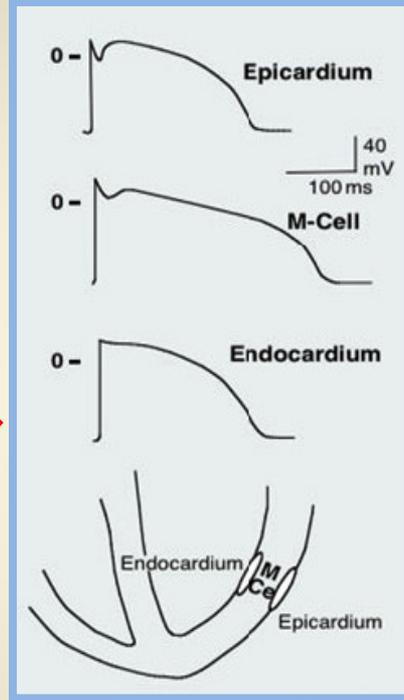
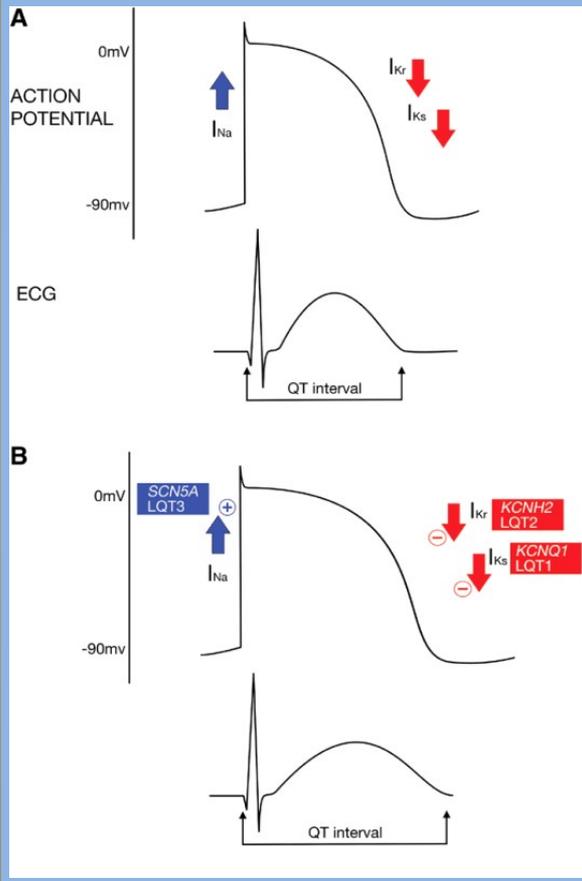
Incidence: 1/2000 births

Type	Current	Functional Effect	Frequency Among LQTS	ECG	Triggers Lethal Cardiac Event	Penetrance*
LQTS1	K	↓	30%-35%		Exercise (68%) Emotional stress (14%) Sleep, response (9%) Others (19%)	62%
LQTS2	K	↓	25%-30%		Exercise (29%) Emotional stress (49%) Sleep, response (22%)	75%
LQTS3	Na	↑	5%-10%		Exercise (4%) Emotional stress (12%) Sleep, response (64%) Others (20%)	90%

Source: Adapted from Rev Esp Cardiol. 2007;60(7):739-5. Published with permission of Elsevier España.

SCD mechanism in Long QT

Incidence: 1/2000 births



SCD mechanism in BrS

Incidence: 1/2000

Brugada Type 1



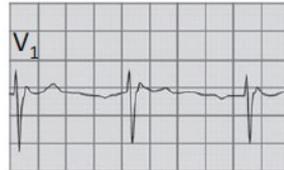
- RBB pattern
- Coved ST-segment
- ≥ 2 mm in V1-V3

Brugada Type 2



- Saddleback ST-segment
- ST-elevation >2 mm
- ST-trough >1 -mm elevation followed by positive or biphasic T-wave

Brugada Type 3

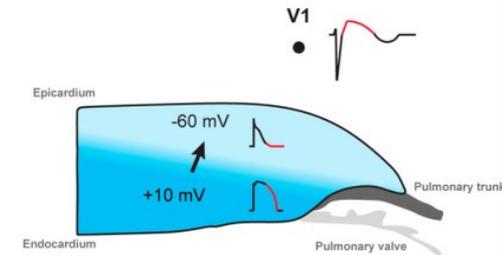
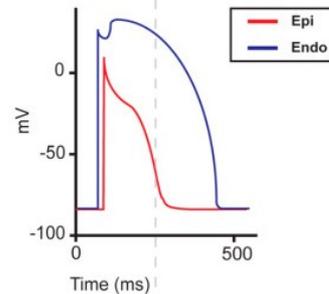


- ST-segment saddle-back or coved
- ST-elevation <1 mm

Mechanism of ST-segment elevation

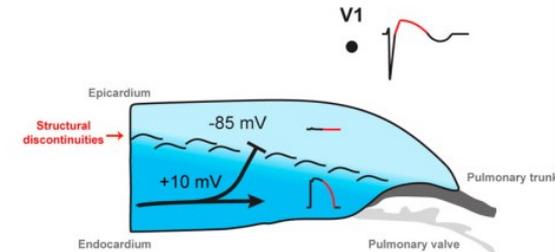
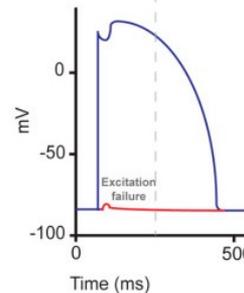
A

Repolarization hypothesis



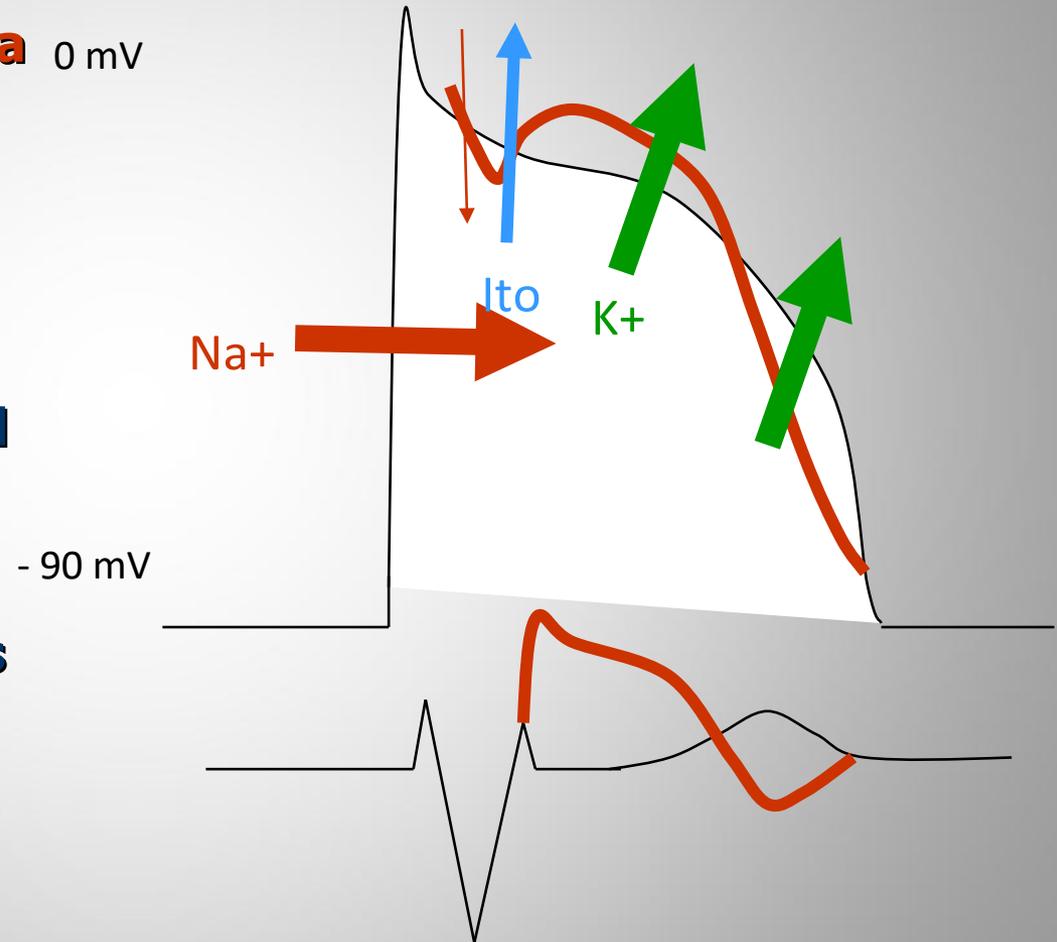
B

Conduction hypothesis

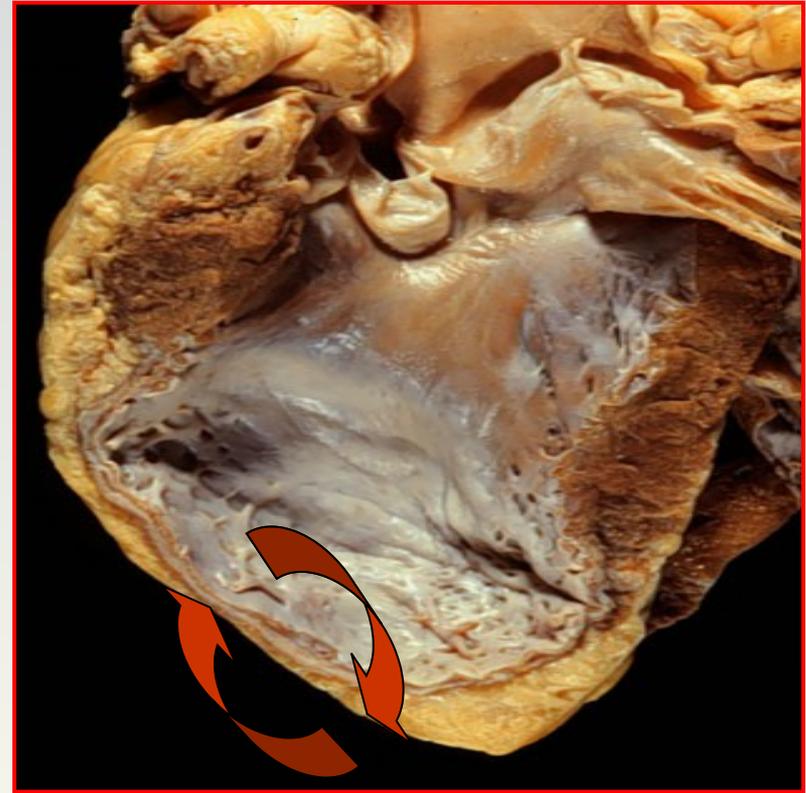
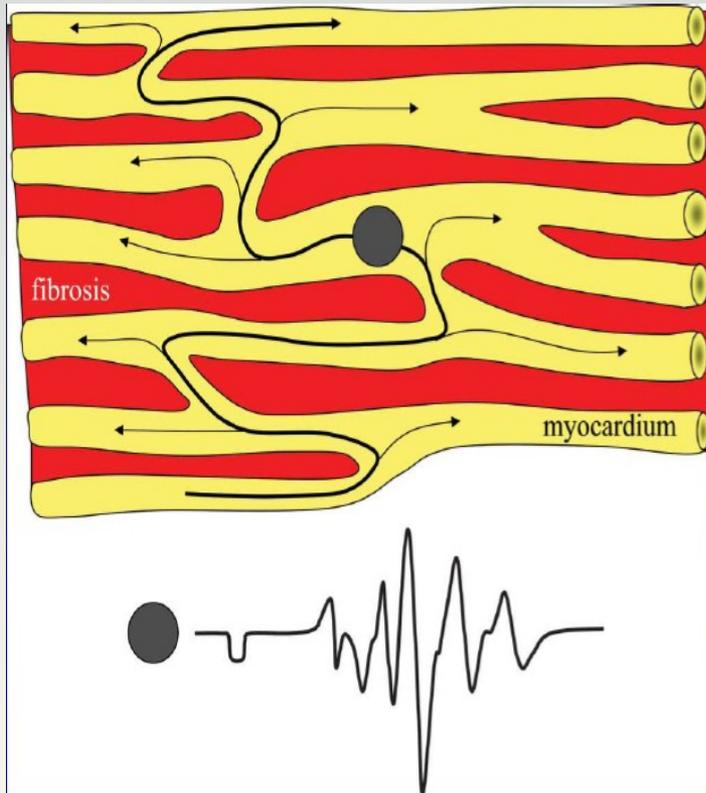


SCD mechanism in BrS

- Some mutations produce **loss of function in the sodium current I_{Na}**
- **Faster inactivation of mutated Na^+ -channels**
- **Accentuation of unopposed I_{to} current in the RV epicardium**
- **Other mutations cause loss of function of the L-type calcium channel**



Fibrosis and risk for SCD



- **Presence and extent of scarring bears no close relationship to LVEF**
- **Heterogeneity in conduction and repolarization**

Risk Factors for Sudden Cardiac Death

□ Previous MI:

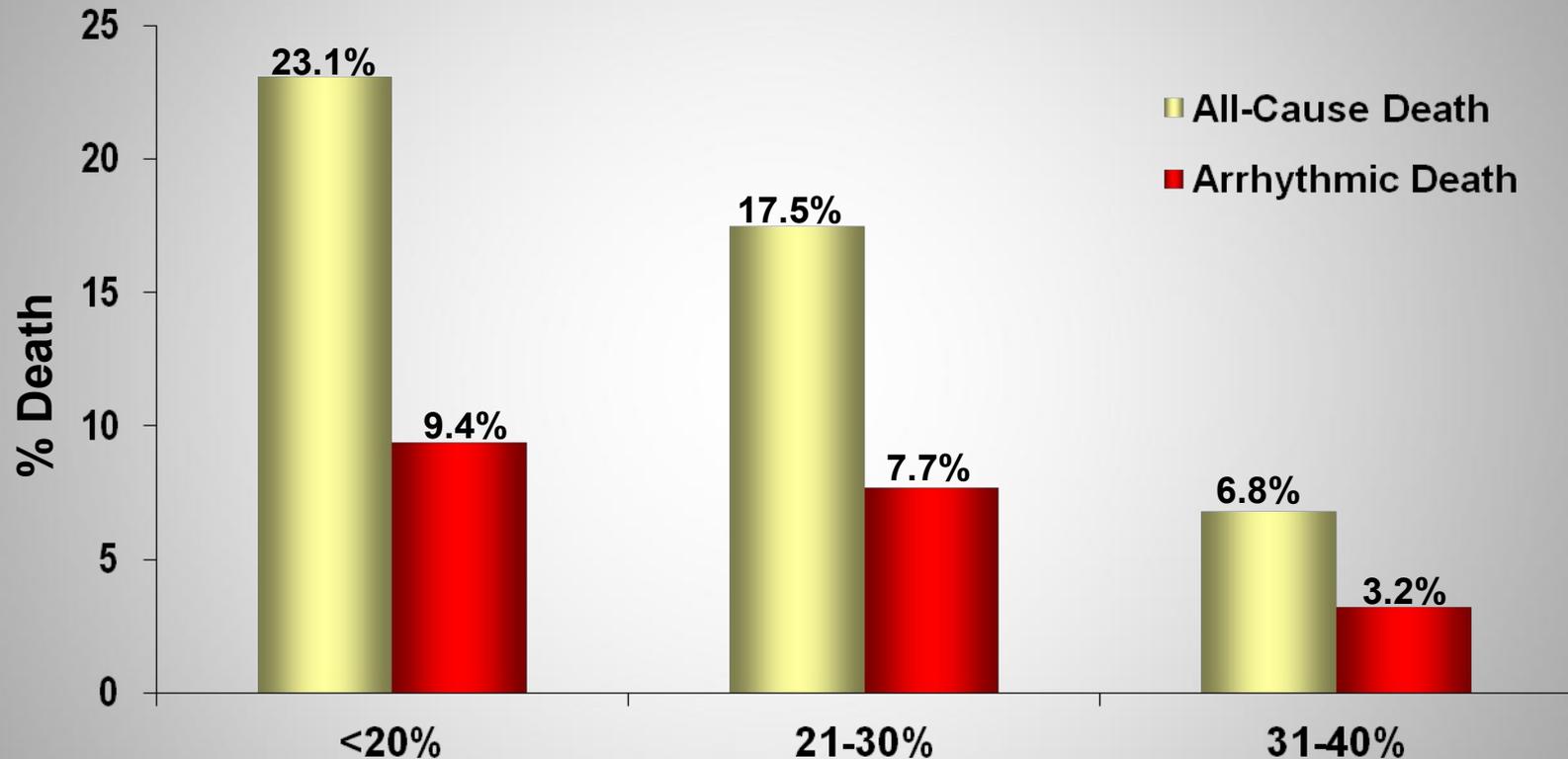
- increases 4-6 times the probability of SCD

□ Heart Failure:

- increases 6-9 times the probability of SCD



Θνητότητα & κλάσμα εξώθησης



“the single most important risk factor for overall mortality and sudden cardiac death”

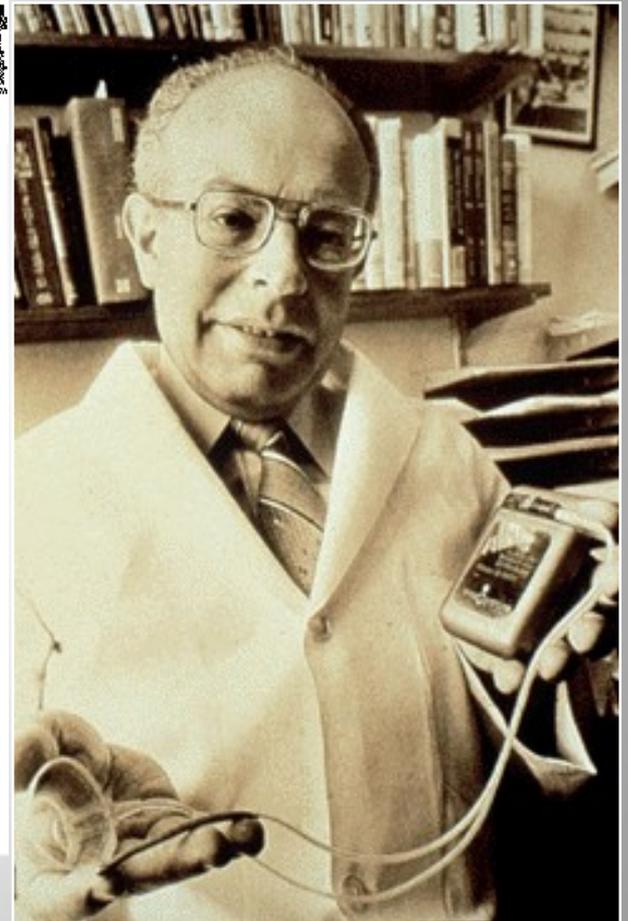
43 χρόνια πριν

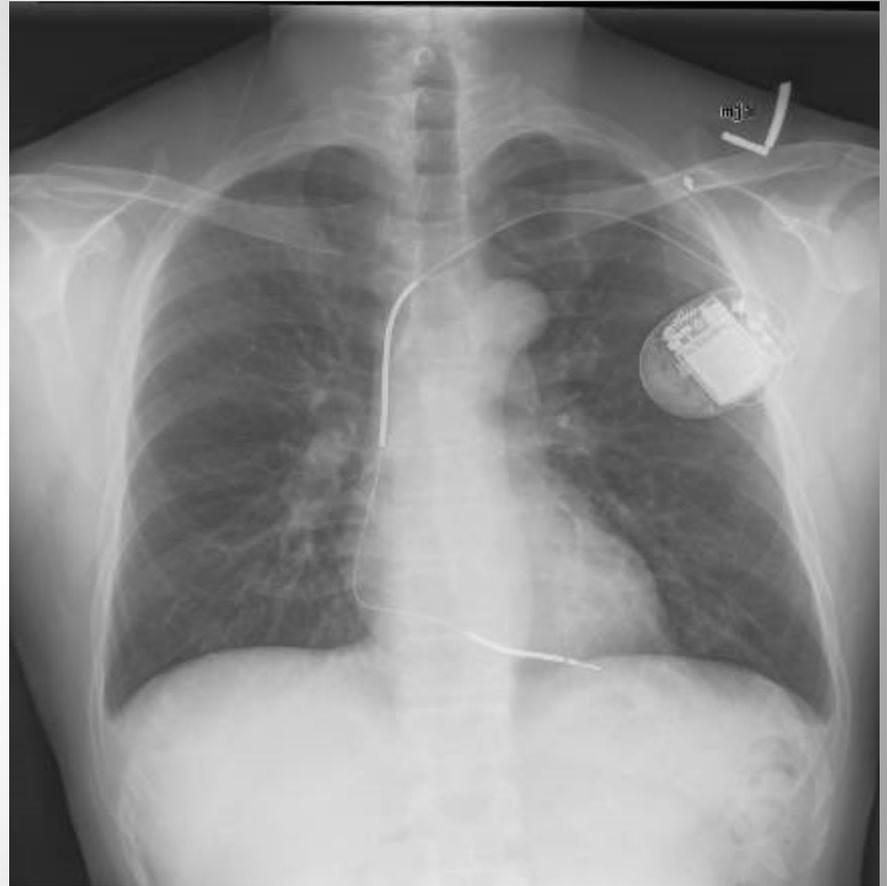
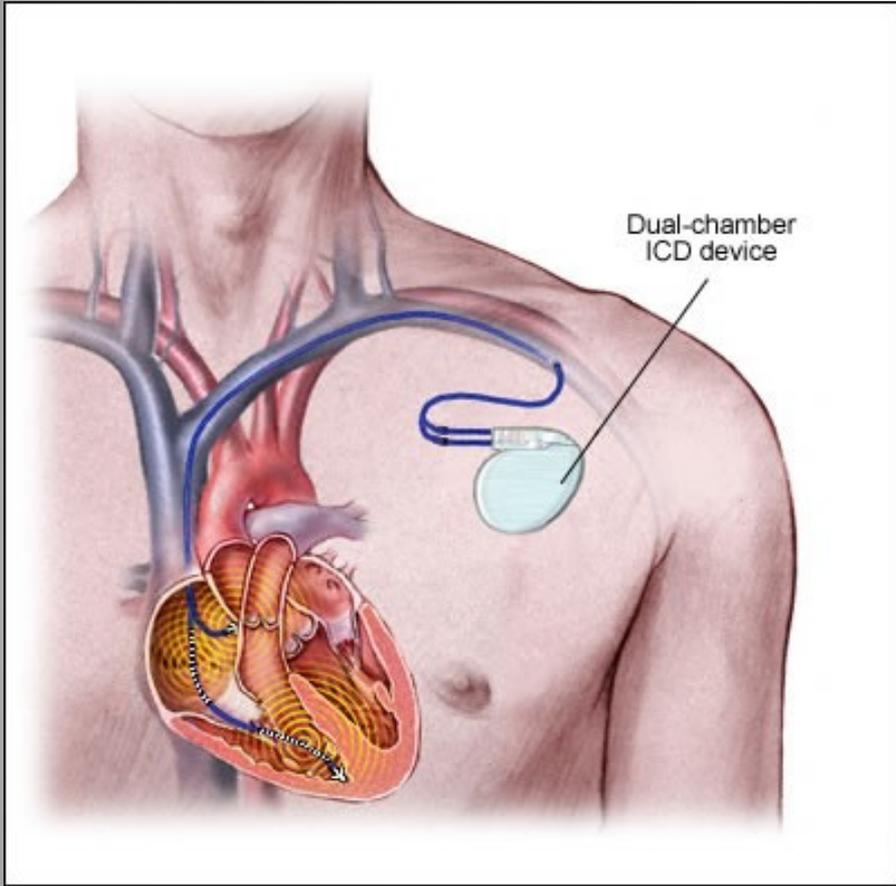
THE NEW ENGLAND JOURNAL OF MEDICINE

August 7, 1980

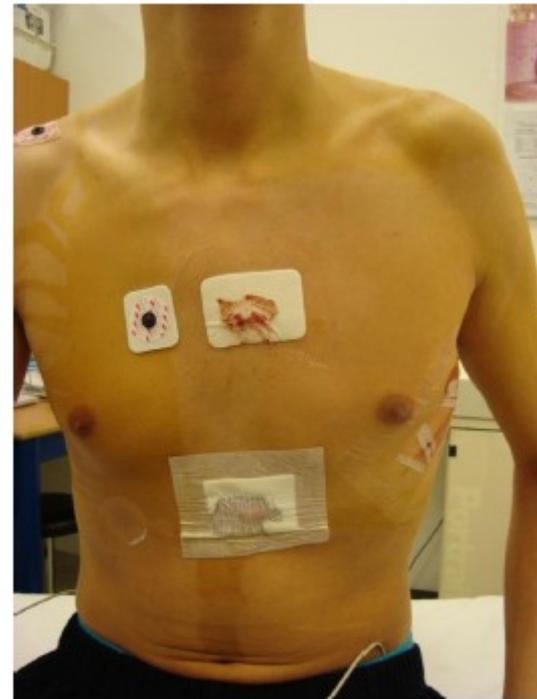
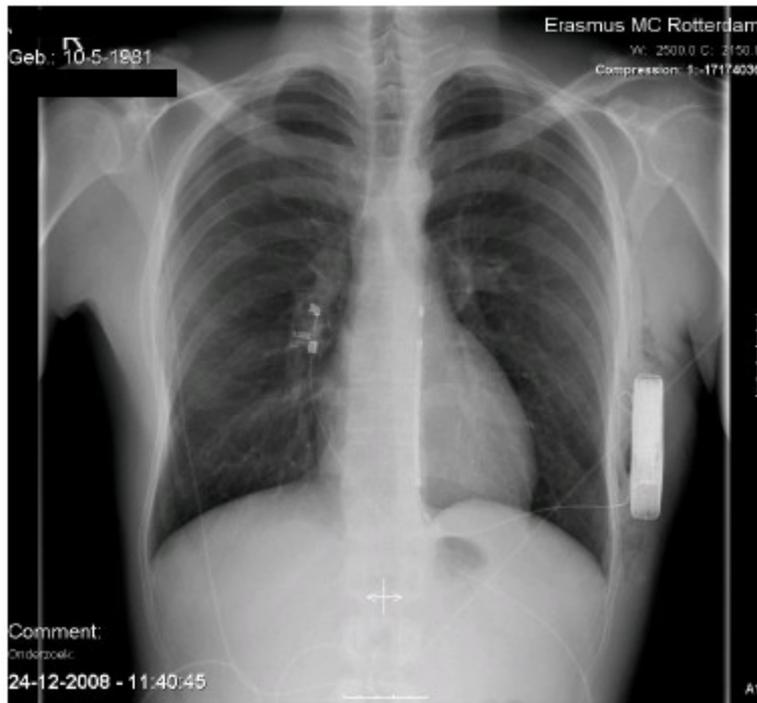
TERMINATION OF MALIGNANT VENTRICULAR ARRHYTHMIAS WITH AN IMPLANTED AUTOMATIC DEFIBRILLATOR IN HUMAN BEINGS

M. MIROWSKI, M.D., PHILIP R. REID, M.D.,
MORTON M. MOWER, M.D., LEVI WATKINS, M.D.,
VINCENT L. GOTT, M.D., JAMES F. SCHAUBLE, M.D.,
ALOIS LANGER, PH.D., M. S. HEILMAN, M.D.,
STEVE A. KOLENIK, M.S.,
ROBERT E. FISCHELL, M.S.,
AND MYRON L. WEISFELDT, M.D.

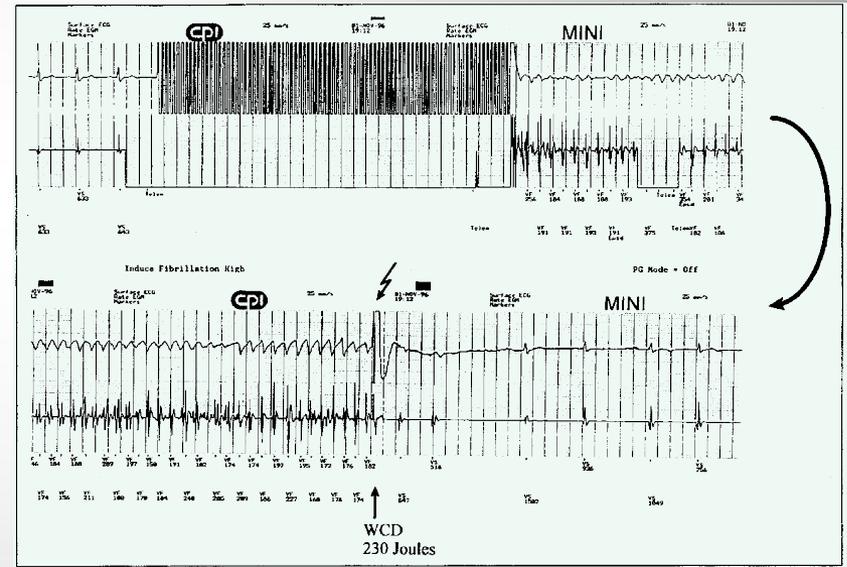




The S-ICD system



Wearable defibrillator



ACC/AHA/ESC Guidelines

ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

A report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines (Writing Committee to Develop Guidelines for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death)
Developed in collaboration with the European Heart Rhythm Association and the Heart Rhythm Society



European Society
of Cardiology

European Heart Journal (2022) **43**, 3997–4126

<https://doi.org/10.1093/eurheartj/ehac262>

ESC GUIDELINES

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Government dilemma

Spending the taxpayers' money



4.5
million €



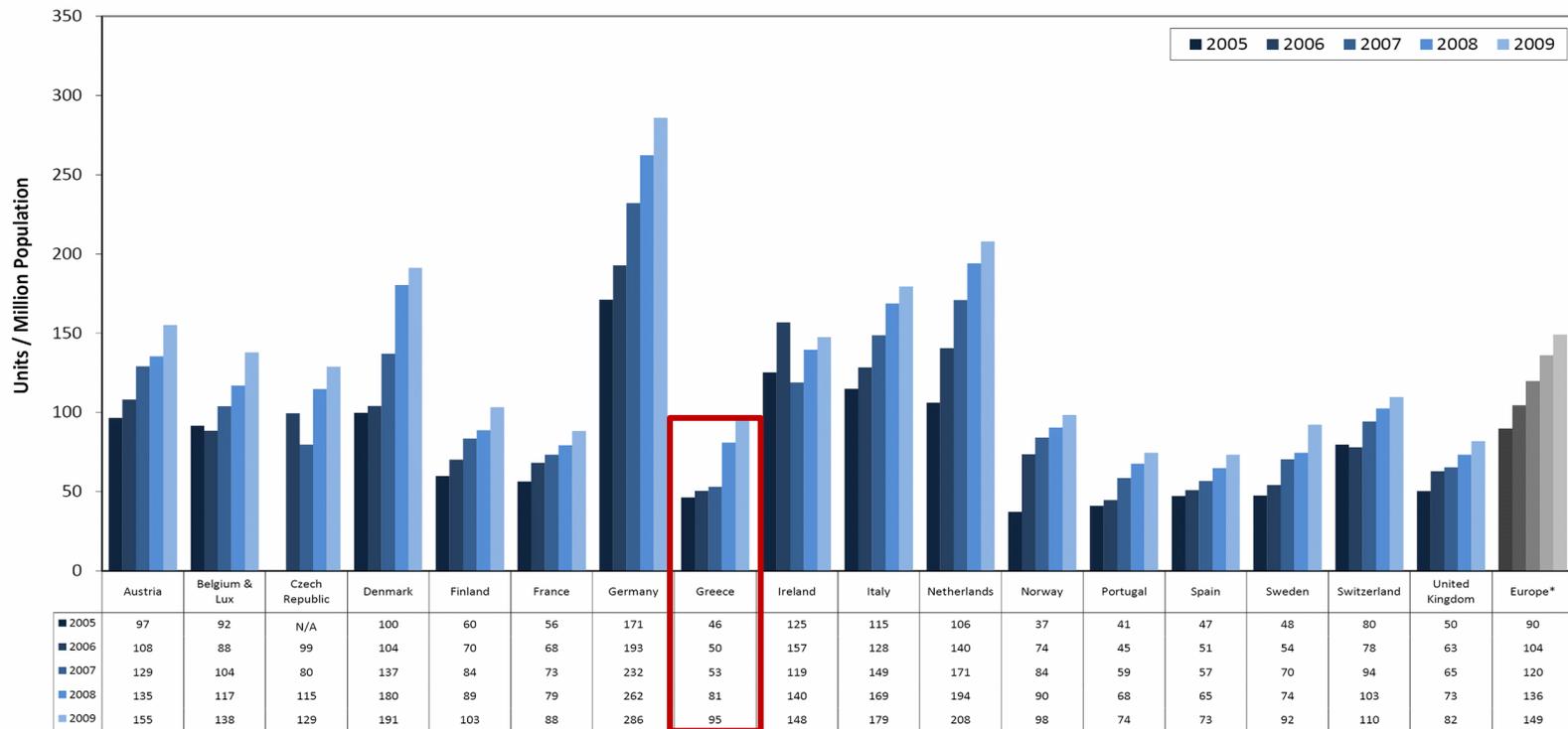
14-18 million €



14 million € annual
front cost for UK

National Differences in ICD implantation

Defibrillators - Units per million inhabitants



National Differences in ICD implantation

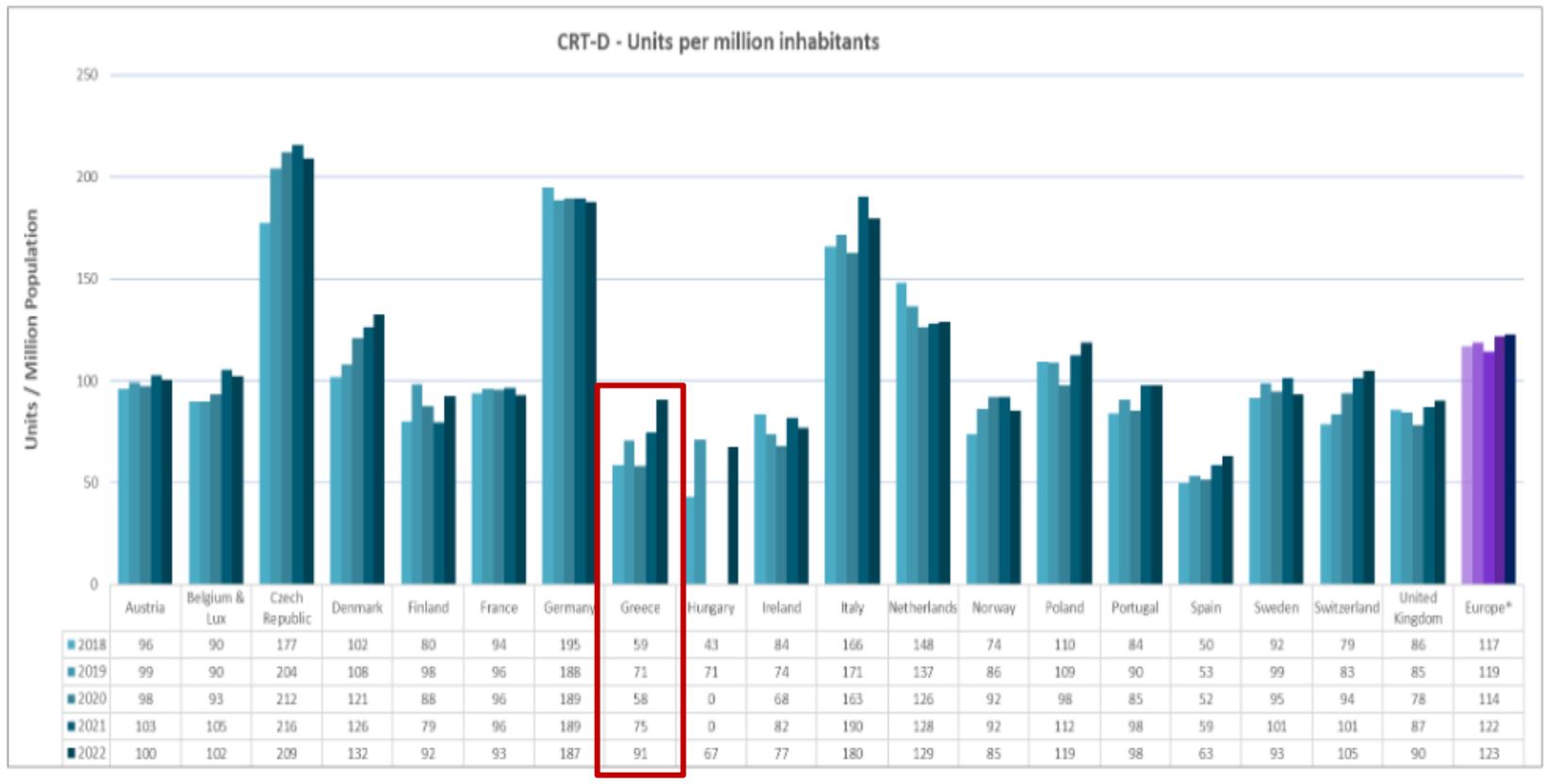


Source population data: Eurostat

Units: MedTech Europe, based on reports from major manufacturers

*Europe represents total of listed countries

National Differences in ICD implantation



Source population data: Eurostat

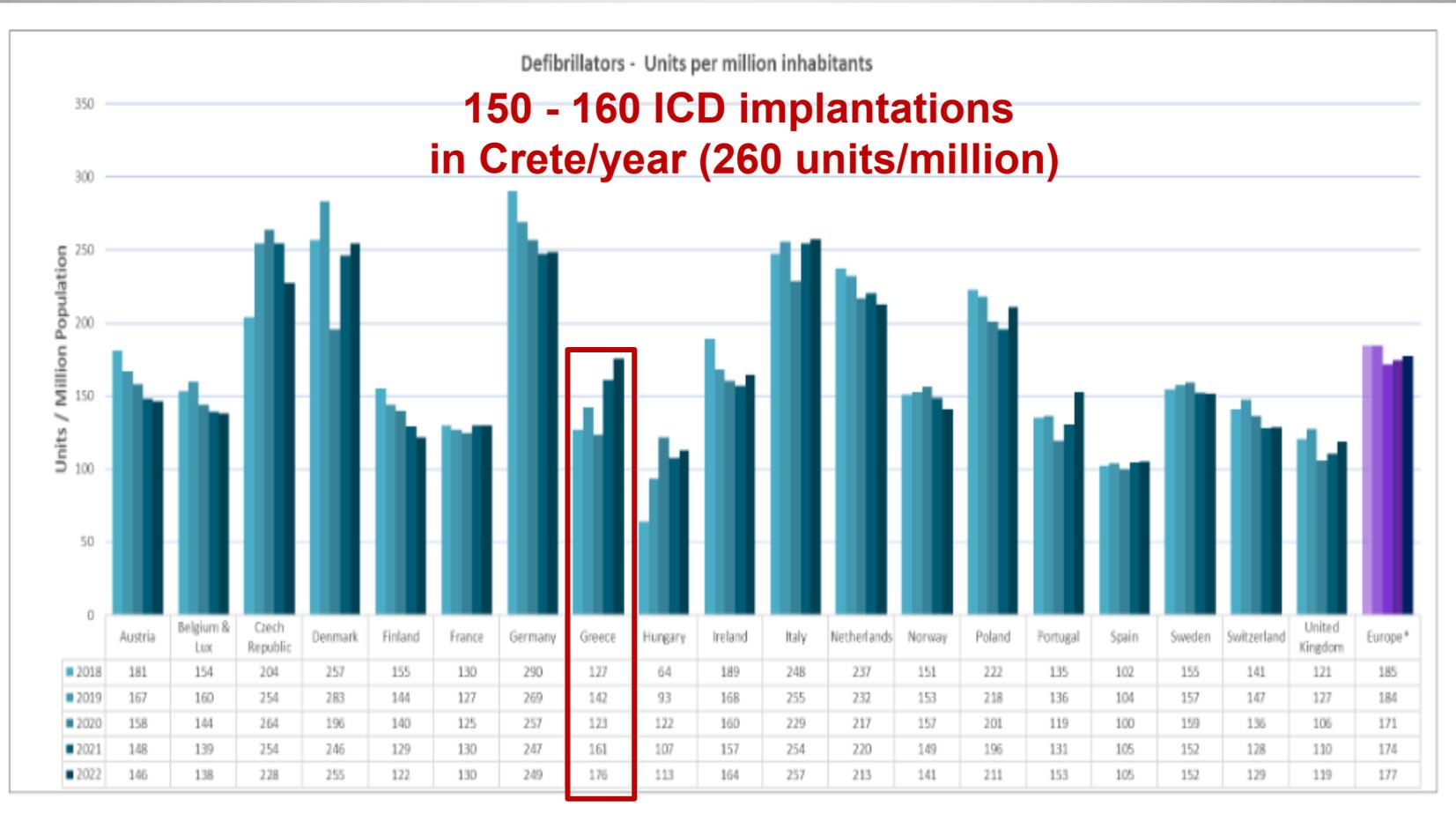
Units: MedTech Europe, based on reports from major manufacturers

*Europe represents total of listed countries

PaGNI Ep lab



National Differences in ICD implantation



Source population data: Eurostat

Units: MedTech Europe, based on reports from major manufacturers

*Europe represents total of listed countries

Towards personalized medicine

The combination of LVEF, MRI with clinical risk factors and genetic testing classify individuals into subpopulations

especially

- **Those at low risk for ventricular tachyarrhythmias despite low EFs**
- **Those with a very high competing risk for non-sudden death**

Incidence of Sudden Cardiac Death in the European Union



There are ongoing European initiatives, including the ESCAPENET and PROFID projects, that aim to develop and validate risk prediction models for SCD in the European Union by combining inherited and acquired risk factors from various areas.

Πρόληψη στεφανιαίας νόσου

- The best means of preventing SCD is by prediction and prevention of CAD through the control of modifiable risk factors
 - Hypertension
 - Smoking
 - Diabetes & Obesity
 - Lipids abnormalities
- These risk factors have poor sensitivity and are nonspecific for arrhythmic deaths

At this time we have no practical way to identify persons in the general population likely to develop SCD

Syncope

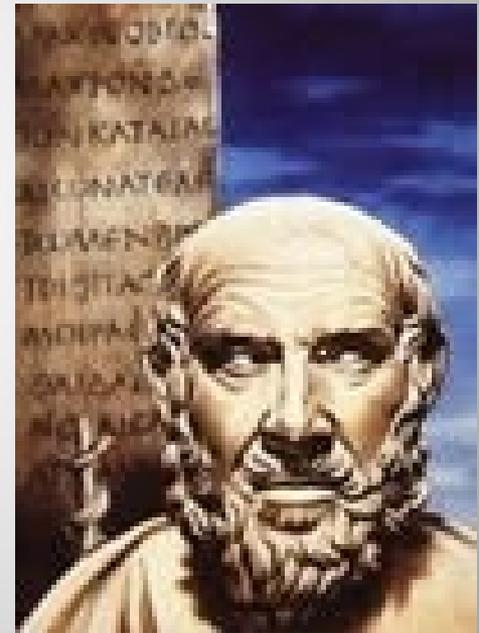
- **Syncope is a transient loss of consciousness due to transient global cerebral hypoperfusion characterized by rapid onset, short duration, and spontaneous complete recovery**



Syncope

**“ Those who suffer
from frequent and
severe syncope often
die suddenly”**

Hippocrates, 460 BC





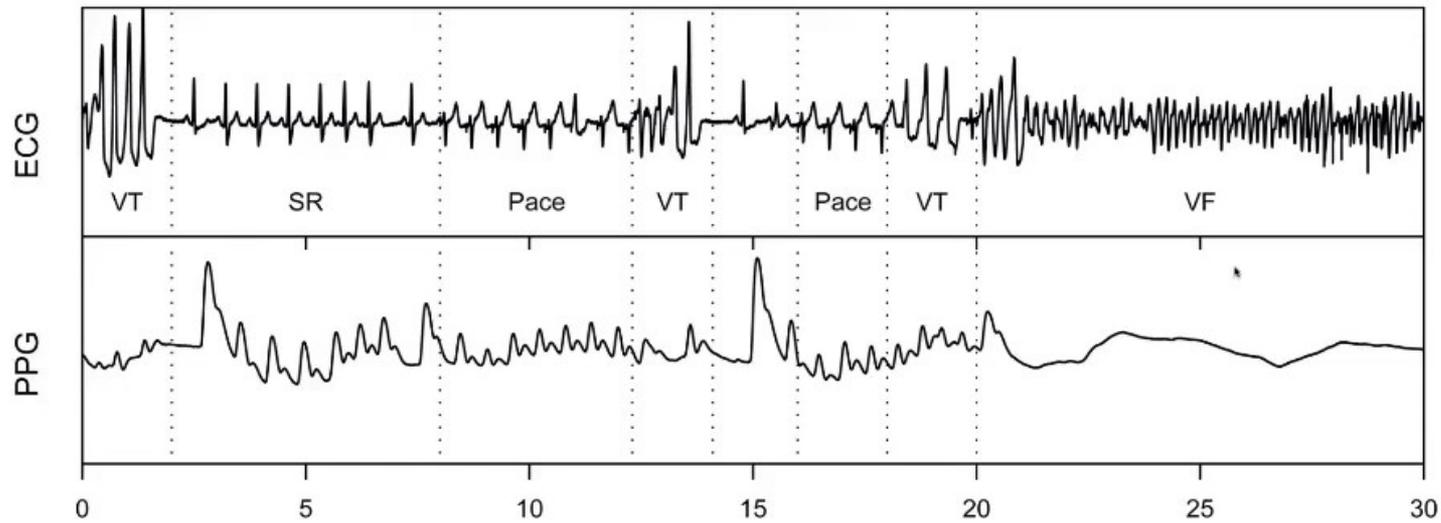
**“The only difference between syncope
and sudden death
is that in one you wake up.”**

Engel GL. Ann Intern Med 1978



"You can't list your iPhone as your primary-care physician."

The future...



The future...





ΕΛΛΑΔΑ 09/09/2019 | 08:48 UPD: 09/09/2019 | 10:29

Σοκ -Πέθανε ο Λαυρέντης Μαχαιρίτσας

Σοκ προκάλεσε η είδηση του θανάτου του τραγουδοποιού **Λαυρέντη Μαχαιρίτσα** • Πέθανε τα ξημερώματα στο σπίτι του στον Πτελεό Μαγνησίας μετά από καρδιακό επεισόδιο, σε ηλικία 63 ετών • Είχε ιστορικό με την καρδιά του και είχε κάνει μπαϊπάς