

ADVANCES IN CARDIAC ARRHYTHMIAS *and* GREAT INNOVATIONS IN CARDIOLOGY

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Centro Congressi
Unione Industriale



Università degli Studi di Torino



Azienda Ospedaliera
Città della Salute e
della Scienza di Torino



**Dipartimento
Cardiocerebrovascolare - Crema**

**Current epidemiology
of sudden cardiac death.
How big is the problem?**

**Giuseppe Inama MD FESC
Crema (Italy)**

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Out of Hospital Cardiac Arrest (OOHCA) Background

Global incidence of SCD

0,5-1 ‰

cases per year

330.000 cases/year in USA

700.000 cases/year in Europe

60.000 cases/year in Italy

Crema



Out of Hospital Cardiac Arrest (OOHCA) Background

Common lethal public problem

Outcome of OOHCA patients presents large and important regional variations (at least 5-fold) and remain dismal

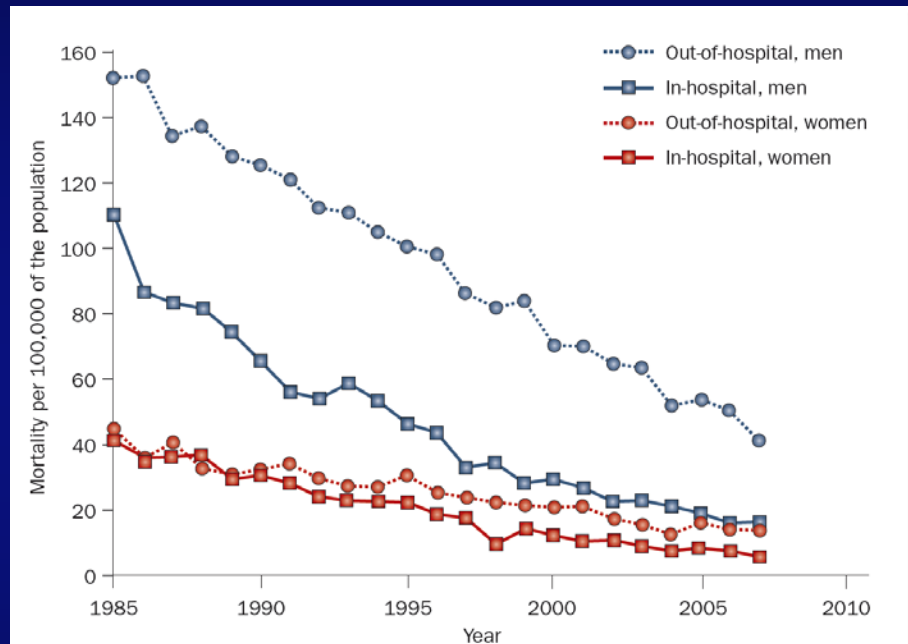
25% generally survive the subsequent hospitalization among the total initially resuscitated

Cause of death after a successful resuscitation: 1/3 central nervous injury system, 1/3 myocardial failure, 1/3 infection – multiorgan failure and many others

SURVIVAL MUST BE IMPROVED!!!!



Epidemiology of SCD



Temporal trends in in-hospital and out-of-hospital cardiovascular mortality among men and women living in Minneapolis-St Paul, MN, USA

- In-hospital mortality for coronary heart disease has declined more rapidly than out-of-hospital mortality
- Despite the reduction of absolute rate of SCD, the incidence of SCD as a proportion of overall cardiovascular deaths has increased, and SCD now accounts for more than half of all coronary heart disease deaths.

Selcuk Adabag et al. 2010

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Incidence of EMS-treated out-of-hospital cardiac arrest in the United States

Thomas D. Rea^{a,b,*}, Mickey S. Eisenberg^{a,b}, Greg Sinibaldi^a, Roger D. White^c

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^b Emergency Medical Services Division, Public Health Seattle and King County, 999 Third Avenue, Suite 700, Seattle, WA 98104, USA

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Metanalisi: 1 gennaio 1980-31 marzo 2003

Table 2
Summary estimates of all-rhythm and ventricular fibrillation cardiac arrest incidence

Estimate method ^a	All-rhythm events	Person-years	Incidence	VF events	Person-years	Incidence
Primary summary estimate	35,801	65,106,802	54.99	11,129	52,193,582	21.32
Sensitivity estimate 1	26,913	31,338,930	52.41	10,239	44,082,710	23.22
Sensitivity estimate 2	19,908	39,492,722	50.41	5389	26,580,502	20.27
Sensitivity estimate 3	16,537	26,149,054	63.24	4765	22,310,005	21.35
Sensitivity estimate 4	—	—	61.73	—	—	25.80
Sensitivity estimate 5	—	—	59.63	—	—	25.60
Sensitivity estimate 6	26,778	46,053,222	58.15	8314	38,529,922	21.57

Incidence is reported per 100,000 person-years. Ventricular fibrillation is abbreviated VF.

Incidenza media 55 (FV 21.32) eventi/100.000 abitanti per anno

Resuscitation 2004

Regional Variation in Out-of-Hospital Cardiac Arrest Incidence and Outcome

Periodo di osservazione: 1/5/2006 → 30/4/2007

Results Among the 10 sites, the total catchment population was 21.4 million, and there were 20 520 cardiac arrests. A total of 11 898 (58.0%) had resuscitation attempted; 2729 (22.9% of treated) had initial rhythm of ventricular fibrillation or ventricular tachycardia or rhythms that were shockable by an automated external defibrillator; and 954 (4.6% of total) were discharged alive. The median incidence of EMS-treated cardiac arrest across

Incidenza media 52 (FV 12,9) eventi / 100.000 abitanti / anno

tricular fibrillation incidence was 12.6 (IQR, 10.6-5.2) per 100 000 population; survival ranged from 7.7% to 39.9%, with a median of 22.0% (IQR, 15.0%-24.4%), with significant differences across sites for incidence and survival ($P<.001$).

JAMA. 2008;300(12):1423-1431

Incidence of EMS-treated out-of-hospital cardiac arrest in the United States

Rea et al Resuscitation 2004

Table 3

Summary estimates of all-rhythm and ventricular fibrillation cardiac arrest survival

Estimate method ^a	All-rhythm events	All-rhythm survivors	Survival	VF events	VF survivors	Survival
Summary estimate	31,919	2670	8.4	11,129	1966	17.7

Sopravvivenza media 8,4% (17,7% per FV)

Regional Variation in Out-of-Hospital Cardiac Arrest Incidence and Outcome

Nichol G et al JAMA 2008

Survival ranged from 3.0% to 16.3%, with a median of 8.4% (IQR, 5.4%-10.4%). Median ventricular fibrillation incidence was 12.6 (IQR, 10.6-5.2) per 100 000 population; survival ranged from 7.7% to 39.9%, with a median of 22.0% (IQR, 15.0%-24.4%),

Sopravvivenza media 8,4% (22% per FV)

Impact of the 2005 American Heart Association cardiopulmonary resuscitation and emergency cardiovascular care guidelines on out-of-hospital cardiac arrest survival.

[Sayre MR](#), [Cantrell SA](#), [White LJ](#), [Hiestand BC](#), [Keseg DP](#), [Koser S](#).

Prehosp Emerg Care. 2009 Oct-Dec;13(4):469-77

***NONOSTANTE GLI SFORZI DI MIGLIORARE
LA QUALITÀ DELLA RCP E PROMUOVERNE
LA DIFFUSIONE
LA SOPRAVVIVENZA ALL'AC RESTA BASSA***

6.1%



9.4%

Survival From In-Hospital Cardiac Arrest During Nights and Weekends

JAMA 2008

Table 3. Cardiac Arrest Outcomes by Day/Evening vs Night^a

	No. (%) [95% Confidence Interval]			Odds Ratio (95% Confidence Interval)	
	Day/Evening (n = 58 593) ^b	Night (n = 28 155) ^b	Total (N = 86 748)	Unadjusted Odds Ratio (Day/Evening vs Night) (N = 86 748)	Adjusted Odds Ratio ^c (Day/Evening vs Night) (N = 86 748)
Survived to discharge	11 604 (19.8) [19.5-20.1]	4139 (14.7) [14.3-15.1]	15 743 (18.1) [17.9-18.4]	1.43 (1.38-1.49)	1.18 (1.12-1.23)
Return of spontaneous circulation longer than 20 min	29 920 (51.1) [50.7-51.5]	12 581 (44.7) [44.1-45.3]	42 501 (49) [48.7-49.3]	1.29 (1.26-1.33)	1.15 (1.12-1.19)
Survival at 24 h	20 236 (35.4) [35.0-35.8]	7931 (28.9) [28.4-29.4]	28 167 (32.5) [32.2-32.8]	1.35 (1.31-1.39)	1.19 (1.15-1.23)
Favorable neurological outcome ^d	8918 (15.2) [14.9-15.5]	3007 (11) [10.6-11.4]	12 015 (13.9) [13.6-14.1]	1.45 (1.39-1.52)	1.17 (1.11-1.23)

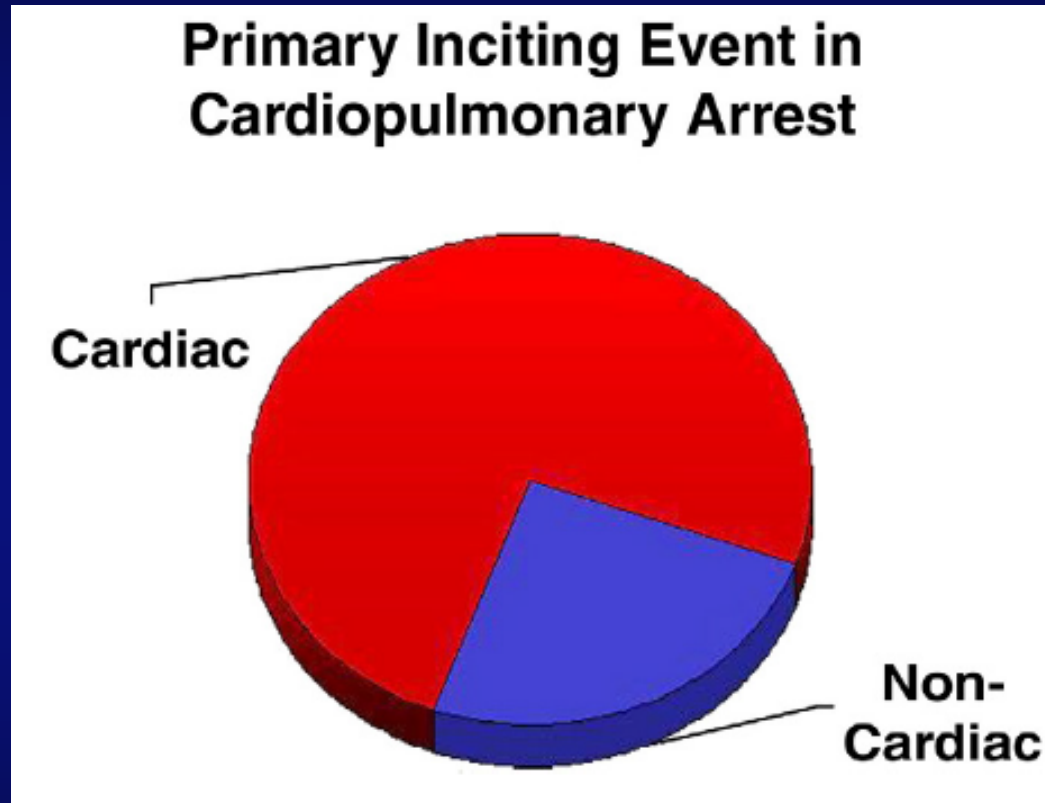
^a $P < .001$ for day/evening vs night for all 4 outcomes.

^bDay/evening was defined as 7:00 AM to 10:59 PM, night as 11:00 PM to 6:59 AM.

^cRegression adjusted for sex, age, race, illness category, discovery status at time of event, witnessed event, first documented pulseless rhythm, duration of cardiopulmonary resuscitation, preexisting conditions, immediate factors related to event, delay in defibrillation, delay in cardiopulmonary resuscitation, delay in vasopressor use, weekend, hospital bed size, time from admission to event, interventions in place at time of event, and pharmacologic interventions.

^dEither a cerebral performance category score of 1 or 2 (range, 1-5) or no change from baseline cerebral performance category score.

Automated external defibrillators (AEDs)



Cardiac etiologies in sudden death represent the most frequently encountered cause. 75% of SD are related to cardiac causes.



Cardiac causes of sudden death

Table 1 *Cardiac causes of cardiac arrest*

Ischaemic cardiac disease (coronary artery disease)
Ischaemic cardiomyopathy
Dilated cardiomyopathy
Hypertrophic cardiomyopathy
Non-atherosclerotic disease of coronary arteries
Valvular heart disease
Arrhythmogenic right ventricular cardiomyopathy
Infiltrative and inflammatory myocardial disease
Congenital heart disease
Primary cardiac electrical abnormalities



Non cardiac causes of sudden death

Table 2 *Noncardiac causes of cardiac arrest*

Pulmonary embolism

Lung disease (hypoxic cause of cardiac arrest)

Electrolyte abnormalities

Bleeding, nontraumatic (hypovolaemic cause of cardiac arrest)

Subarachnoid haemorrhage

Drug overdose

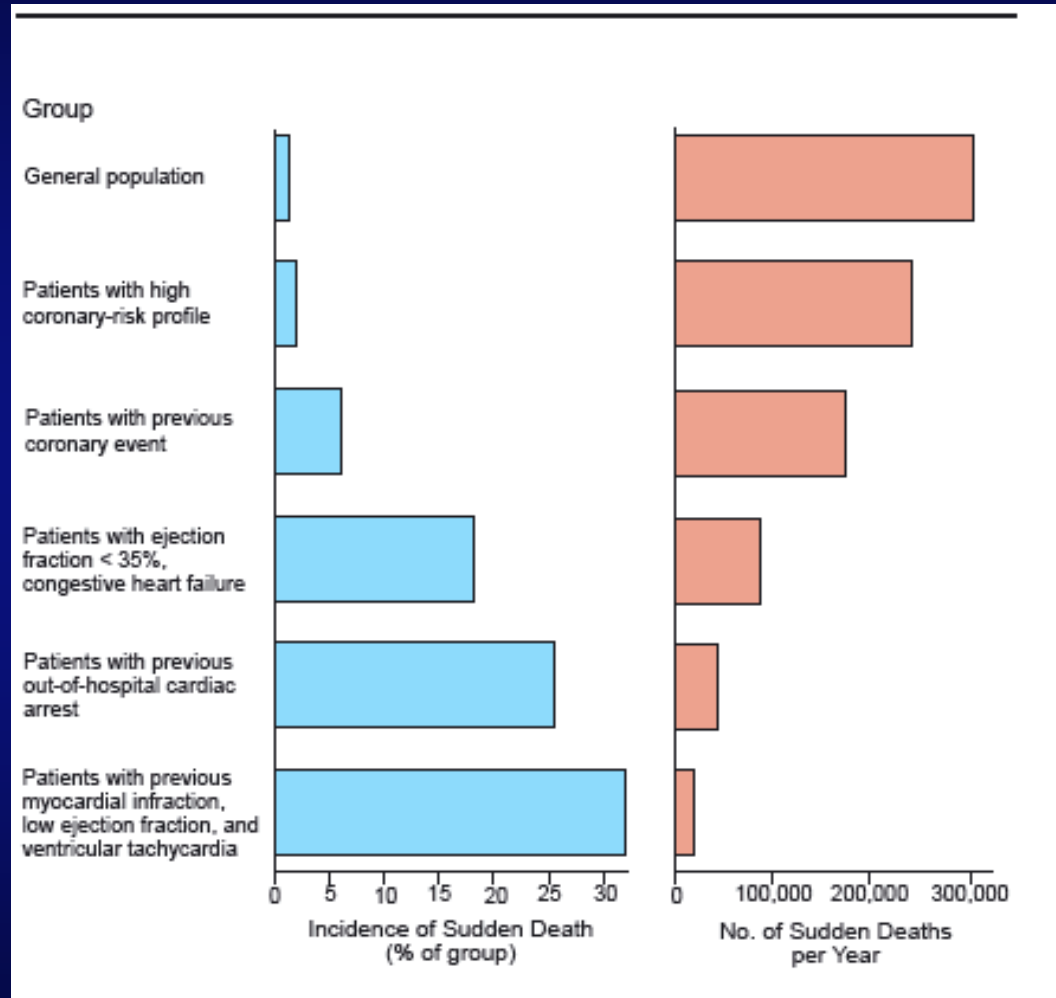
Suffocation

Drowning

Sudden infant death syndrome



Paradosso epidemiologico della SCD



Epidemiology of SCD

- Deaths from SCD has declined over the past several decades, in parallel with decrease in mortality from coronary heart disease
- A 49% decrease in risk of SCD over 50 years was observed in Framingham Heart Study, and it was more pronounced among patients with known coronary heart disease

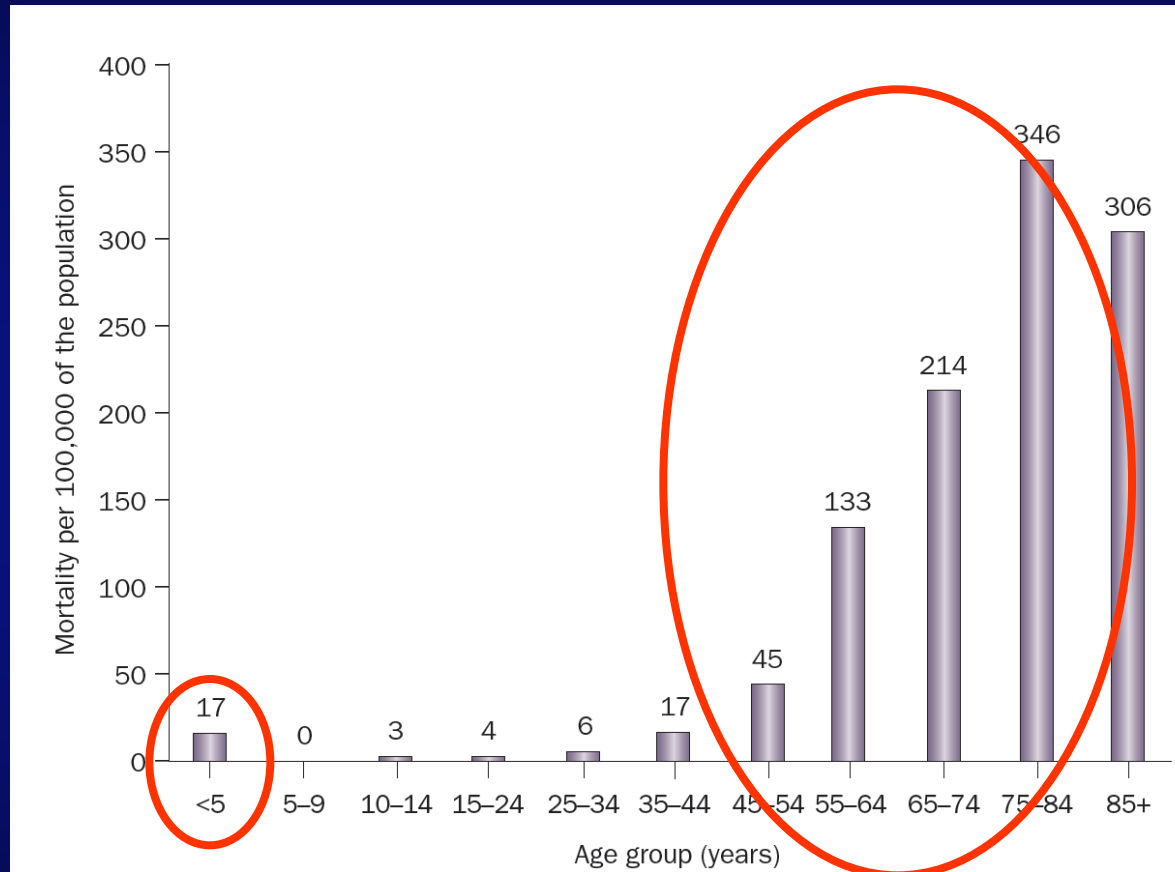


Age distribution of SCD

- The age distribution of SCD demonstrates peaks during infancy and after the age of 45 years.
- In adults, the risk of SCD increases with age and mirrors the incidence of coronary heart disease, whereas in the young (< 30 years of age), the most common causes of SCD include cardiomyopathies, arrhythmogenic disorders, and drug abuse



Age distribution of SCD



Age distribution of SCD among residents in Multnomah County, OR, USA.

Chugh et al. 2004

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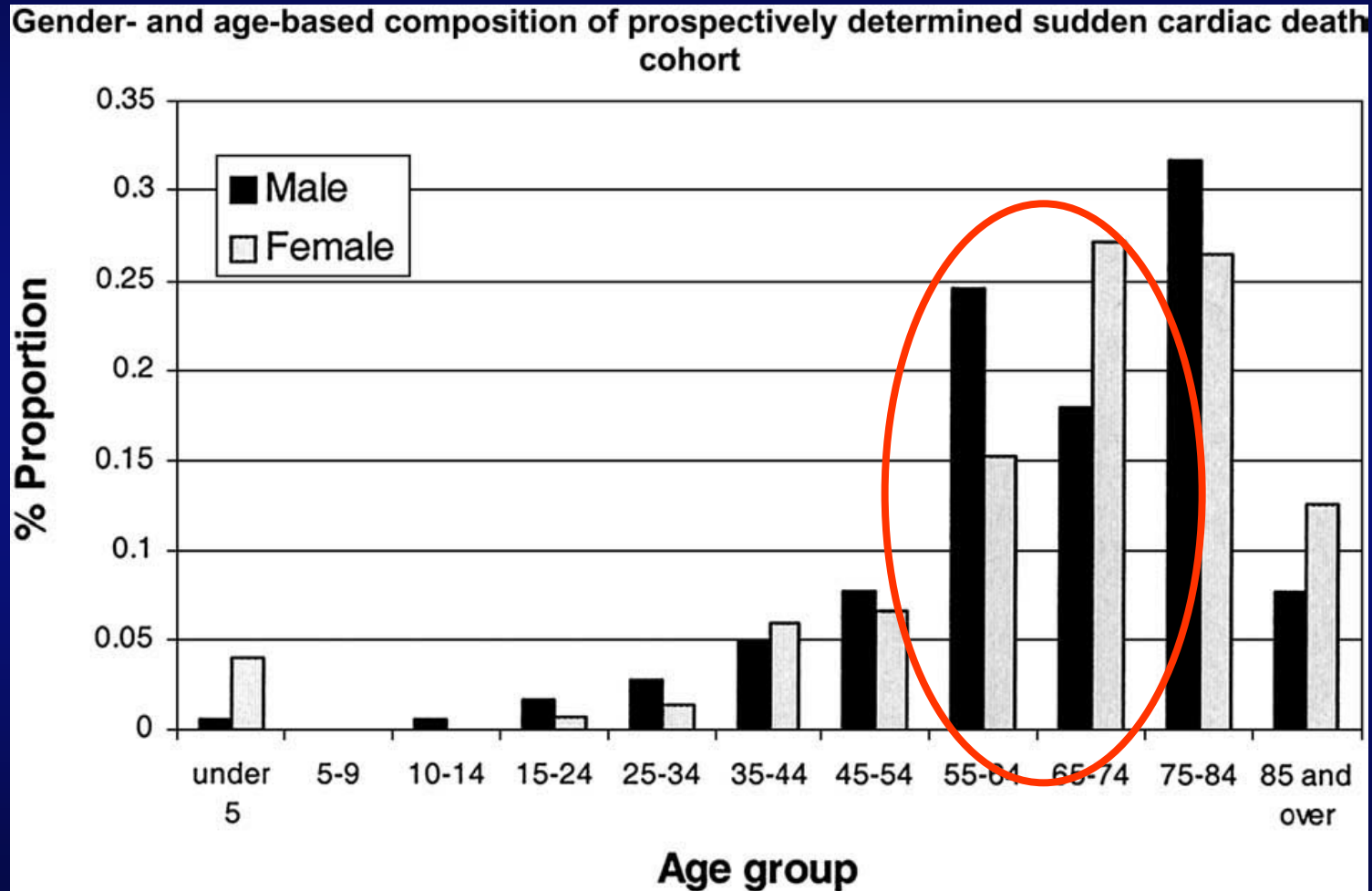
Gender and racial distribution of SCD

Middle-aged men have a fourfold greater risk of SCD when compared with women of the same age. However, this difference decreases with age, possibly as a result of the postmenopausal development of coronary heart disease

Racial differences in the incidence of SCD have not been well investigated. The available data suggest that SCD is more common in African Americans than in white and Hispanic Americans



Age and gender distribution of SCD



[Chugh S.S. Progress in Cardiovascular Diseases, 2008;51(3):213-8]

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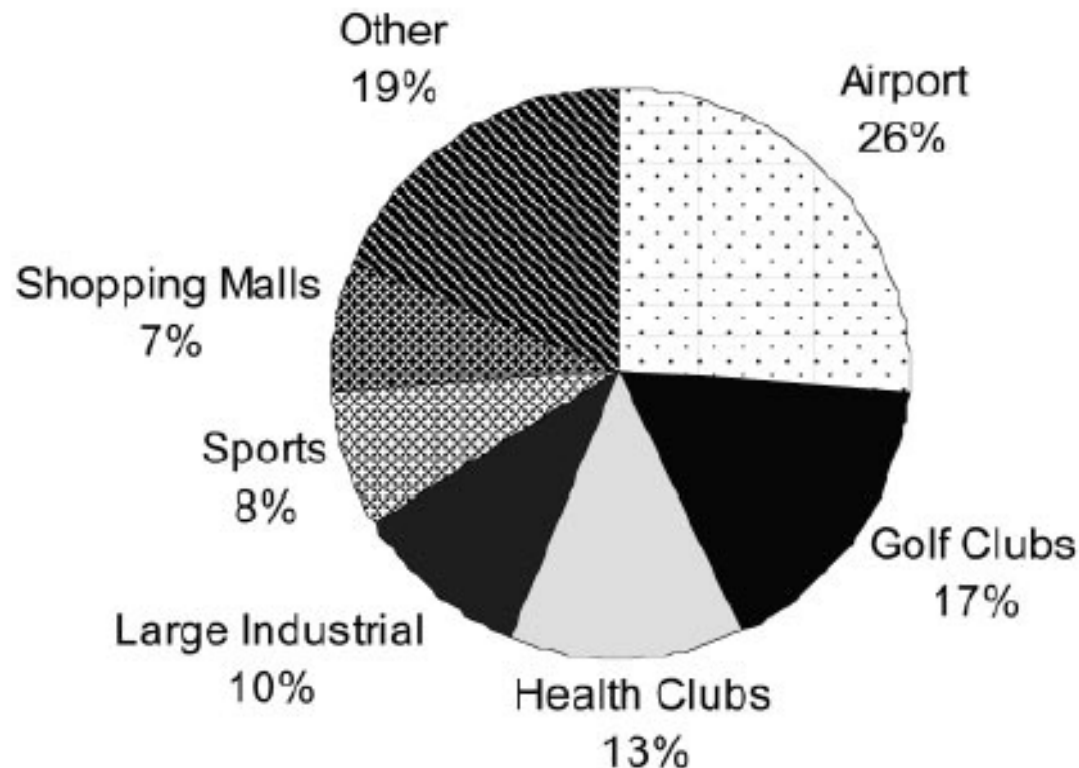


Temporality of SCD

- Approximately 80% of SCD occur in the home and around 60% are witnessed.
- Several studies have demonstrated that there is a heightened risk of SCD on Mondays, in the early hours of the morning (5 to 9 AM), and during the winter months, with particular association with lower temperatures.
- These temporal variations are thought to be secondary to increased ischemia owing to factors such as increased adrenergic activity



Distribuzione % dei luoghi dove avvengono gli AC



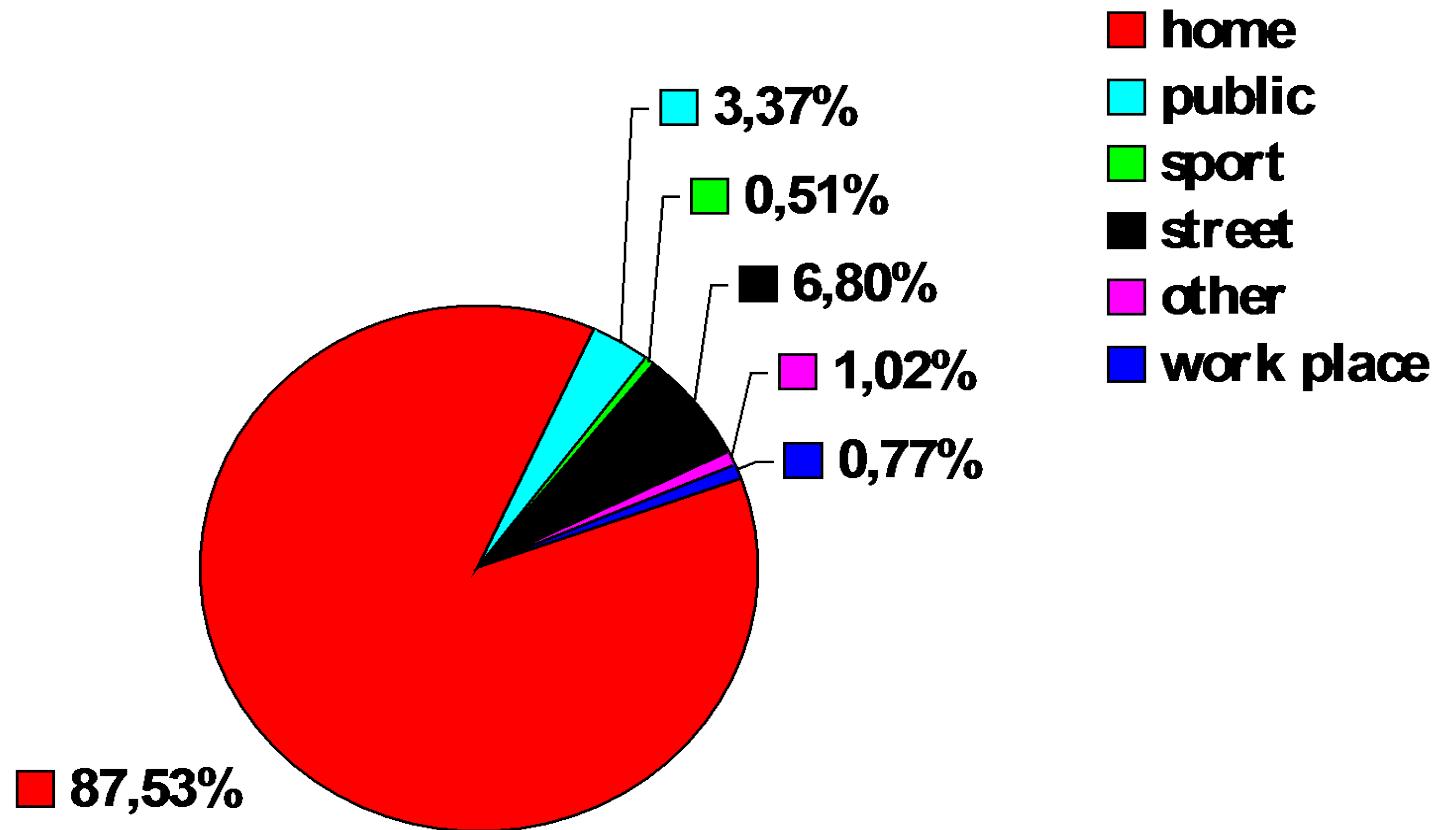
Public locations with high incidence of SCA in Seattle and King County, Washington, 1990 to 1994 (n=134). Adapted with permission from Becker et al.²⁷ Copyright 1998 American Heart Association.



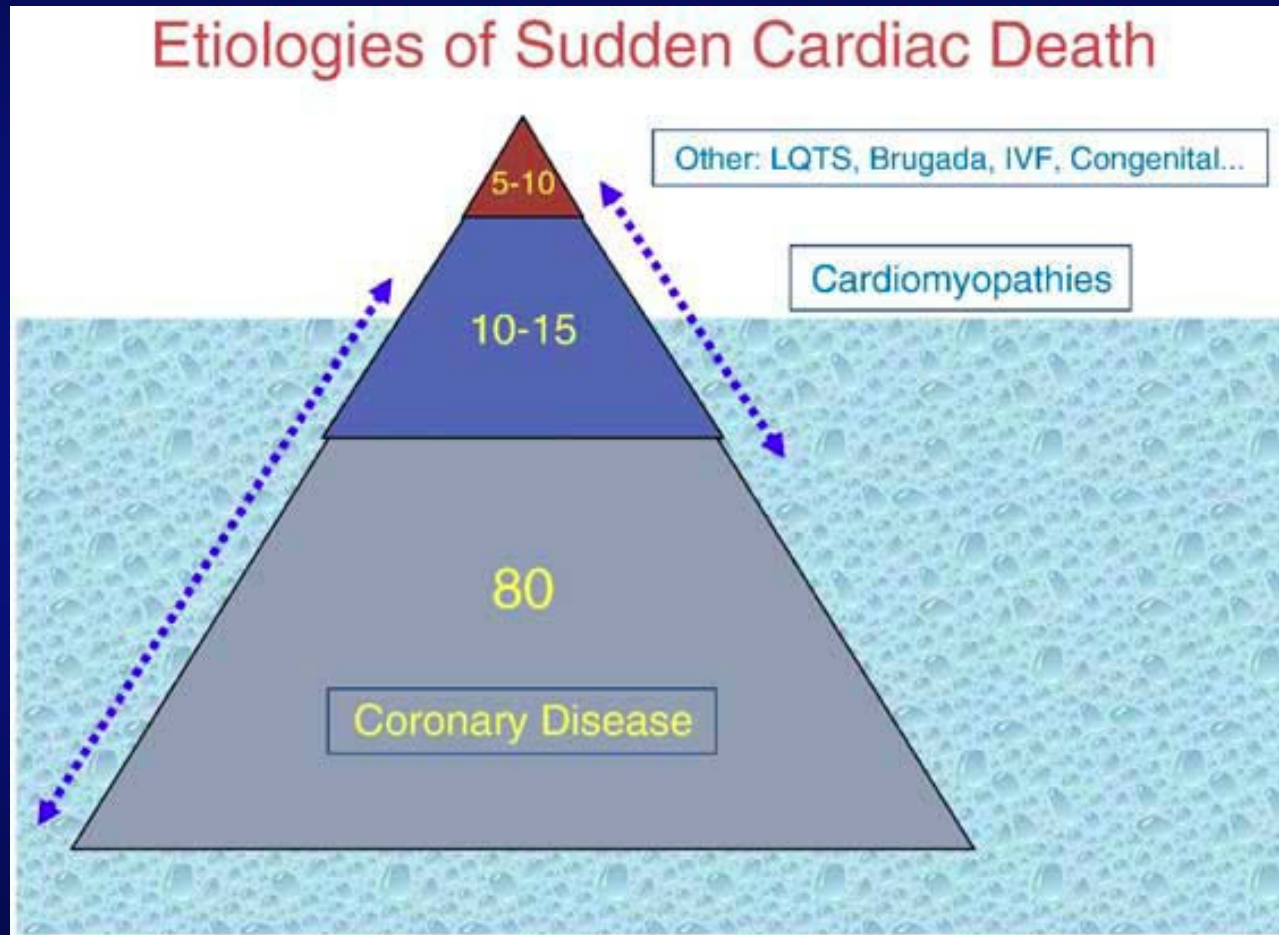
Distribuzione % dei luoghi dove avvengono gli AC

Piacenza Progetto Vita:

Sites of sudden death, tot. n° 1956



Current epidemiology of SCD: how big is the problem?

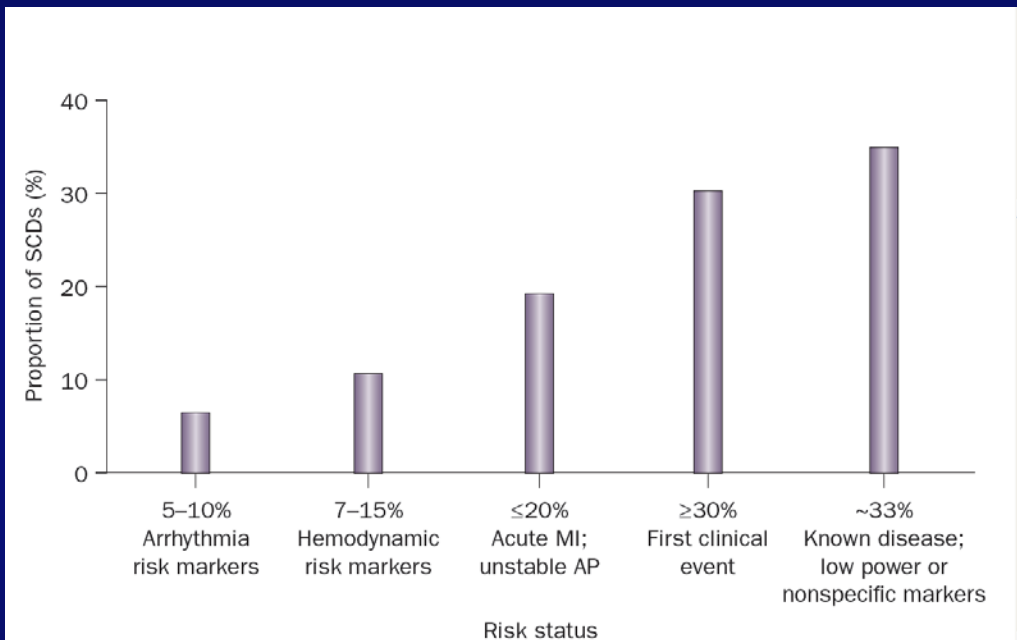


[Chugh S.S. Progress in Cardiovascular Diseases, 2008;51(3):213-8]

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Clinical predictors of SCD



Only a minority of patients have arrhythmic or hemodynamic risk factors of SCD

In a considerable number of patients SCD is the first clinical events of heart disease.

Selcuk Adabag et al. 2010



Electrocardiographic markers of SCD risk

Box 1 | Electrocardiographic markers of SCD risk

12-lead electrocardiography

- Pathologic Q waves or dynamic ST-segment changes
- Prolonged QRS duration
- Increased R-wave voltage
- Fragmented QRS
- Prolonged QT interval

Exercise electrocardiography

- Reduced heart-rate recovery
- Reduced functional capacity
- Increased ventricular ectopy
- T-wave alternans

Signal-averaged electrocardiography

- Late potentials

Ambulatory Holter electrocardiography

- Reduced heart-rate variability
- Nonsustained ventricular tachycardia

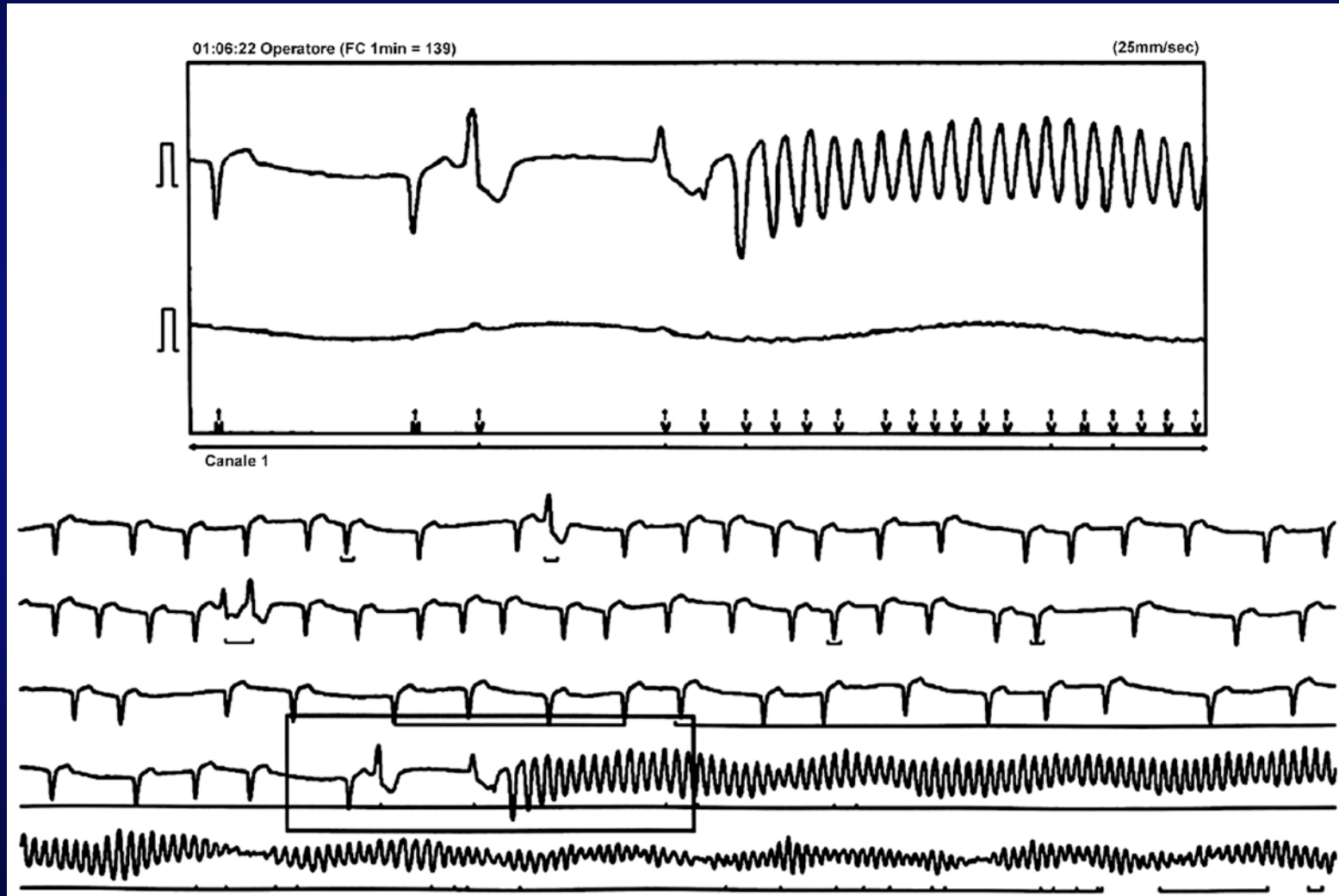


Mechanisms of SCD

- VF precipitated by VT, either monomorphic or polymorphic, is a common mechanism of CA although rapid VT can also be a mechanism.
- Primary VF without preceding VT is another common mechanism.
- Bradyarrhythmia and asystole are less common causes of SCD.
- Pulseless electrical activity and asystole are the most common rhythms seen in CA caused by pulmonary embolism.



Mechanisms of SCD

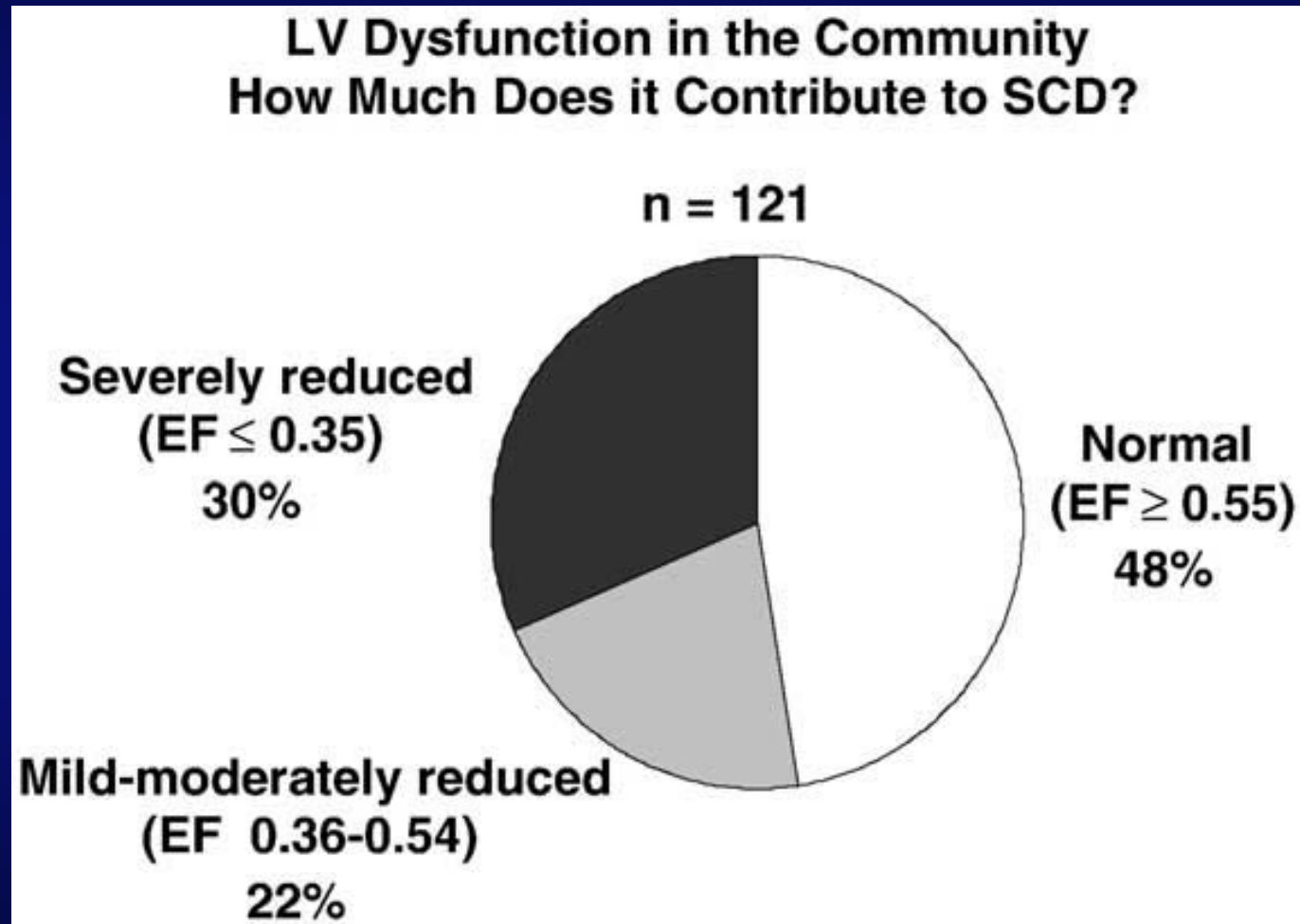


Variation in rhtyhm presentation

- There was a 43% decline in the incidence of VF as the causative rhythm disturbance between 1980 and 2000 among pts treated with out-of-hospital cardiac arrest in Seattle, and similar reductions have been reported in Sweden and Finland
- The reasons for this change are speculative, but could be related with aging of the population, with higher prevalence of heart failure (asystole is often the initial rhythm in cardiac arrest caused by heart failure).



Current epidemiology of SCD: how big is the problem?



[Chugh S.S. Progress in Cardiovascular Diseases, 2008;51(3):213-8]

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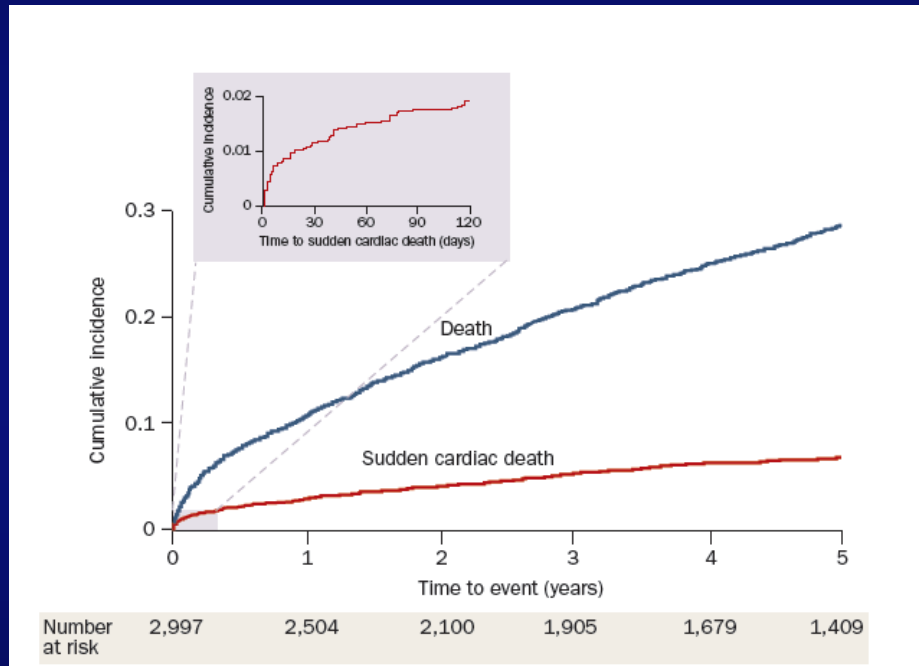


Sudden death after myocardial infarction

- The risk of SCD is higher in the first 100 days after MI and decreases gradually with time.
- Among survivors of MI with left ventricular dysfunction or heart failure the risk of SCD has been reported to be 1.4% in the first 30 days, but 0.14% per month after 2 years.



Sudden death after myocardial infarction



- In a community-based cohort the risk of SCD was 1.2% within the first month after MI, markedly exceeding the risk in general population.

- Thereafter, the SCD risk declined markedly to 1.2% per year, which is lower than expected in general population, as a result of secondary prevention measures.

Cumulative incidence of SCD and all-cause mortality after MI. The shaded area represents the cumulative incidence of SCD during the first 120 days after MI



Automated external defibrillators

Wearable Defibrillator (WCD)

WCD 4000

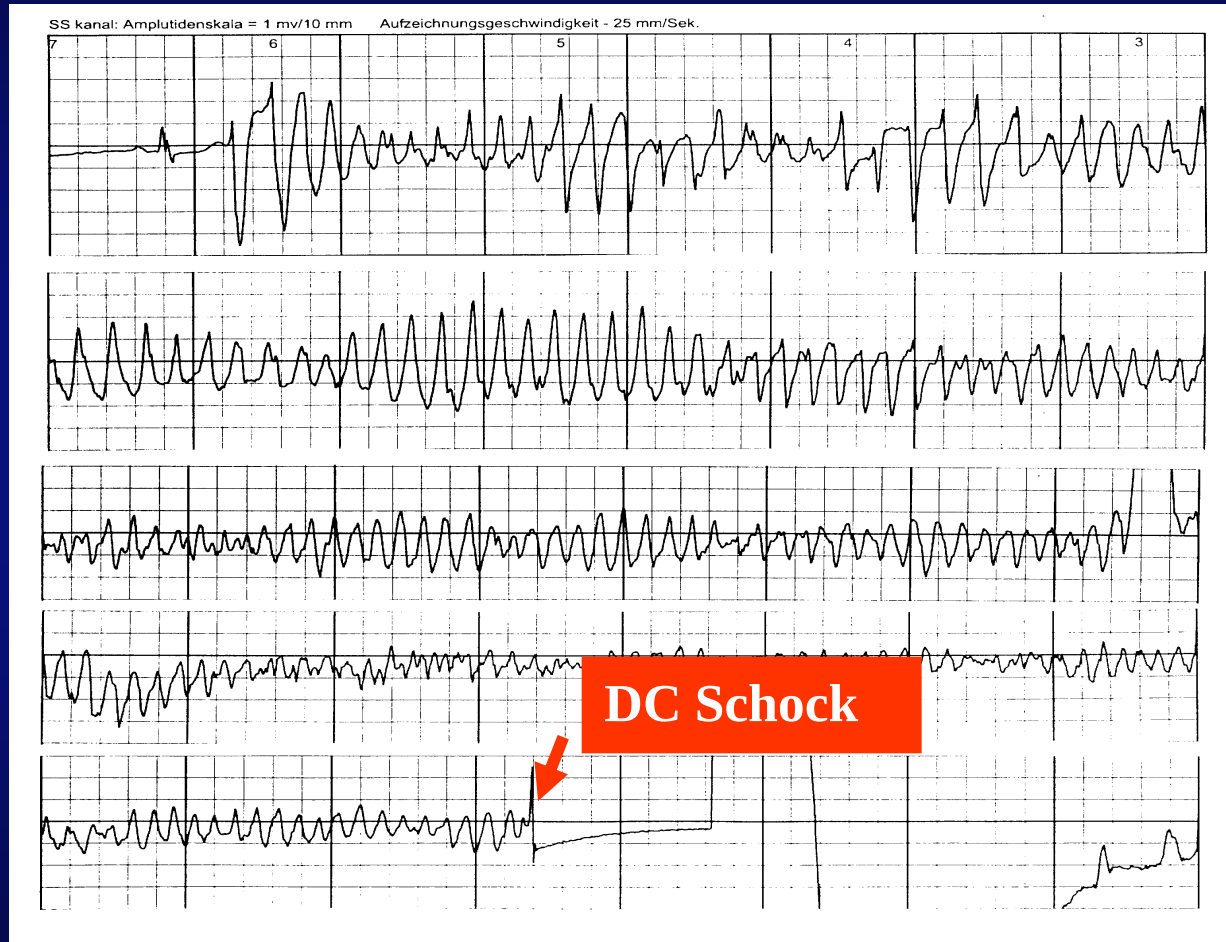


(Courtesy by Horst Esser, ZOLL Comp.)

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Automated external defibrillators

Wearable Defibrillator (WCD)



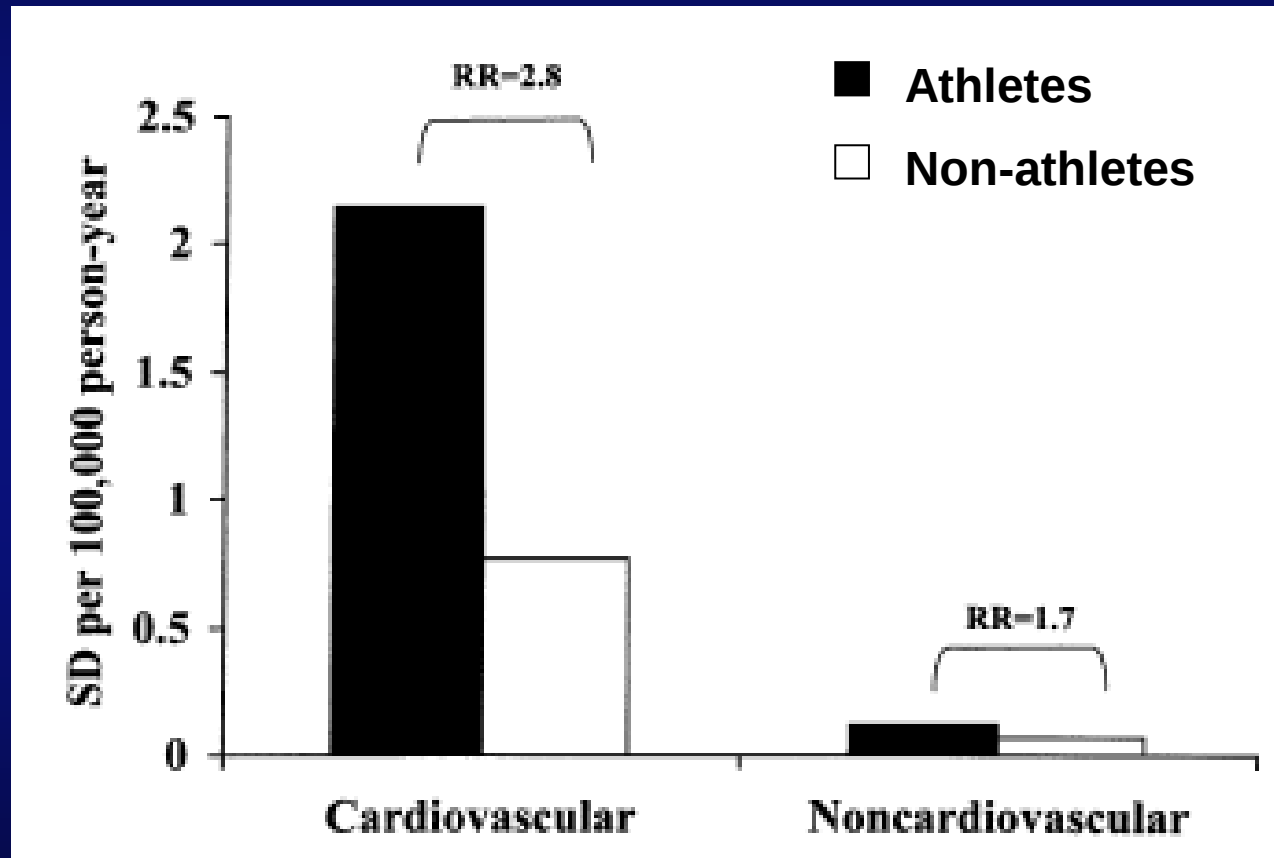
1:31 am

E. R. 47 y, 4 weeks after AMI, at home; LV-EF: 20%

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Incidence of SD among athletes and non-athletes from cardiovascular and non-cardiovascular causes

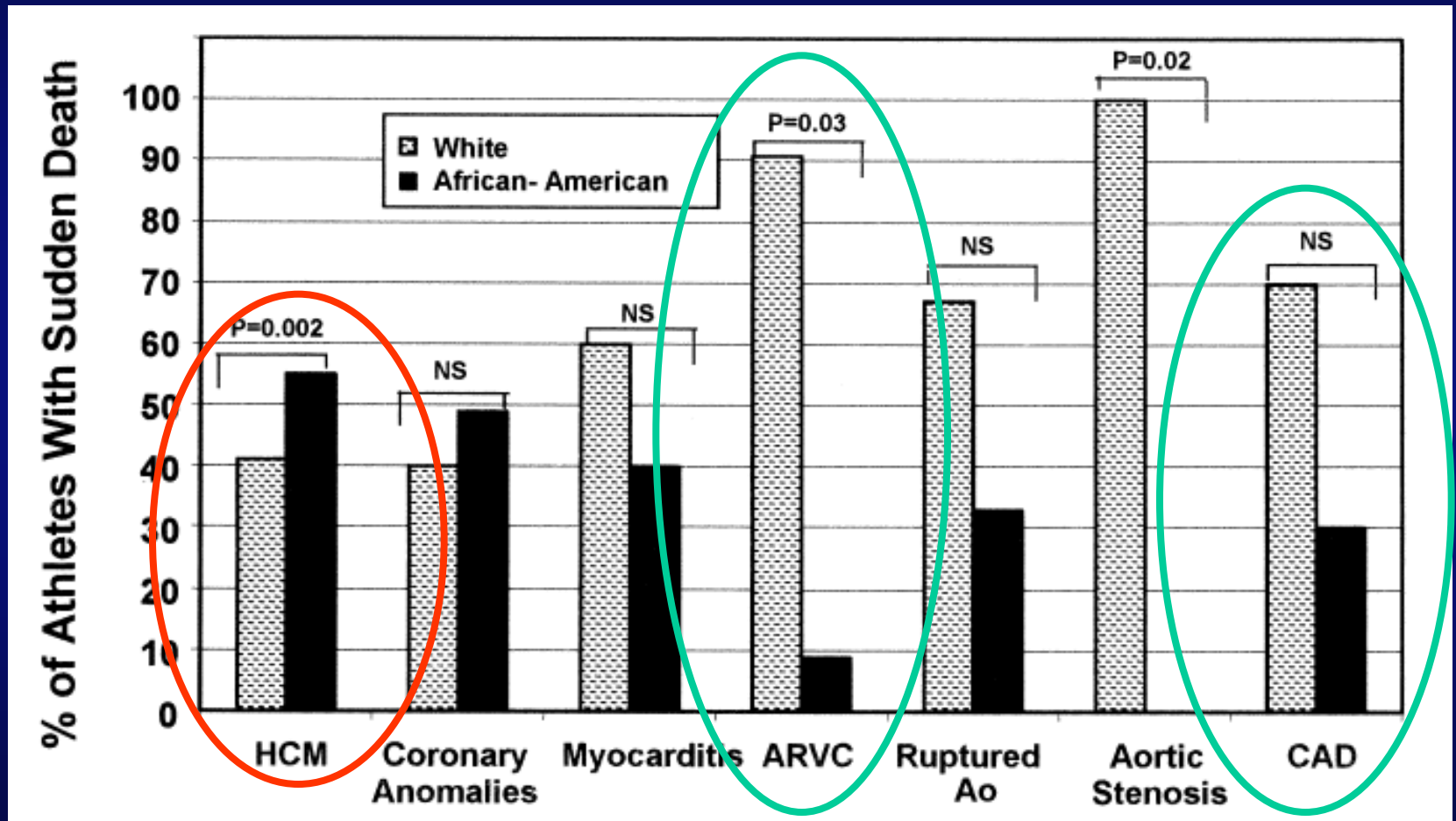


Corrado D et al, JACC 2003;42:1959-63

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Impact of race on cardiovascular causes of CD in competitive athletes



Maron BJ et al, JACC 2003;41:974-80

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Progetto “Crema vita” 2012-2013



“Progetto Crema Vita”

Soggetti e Istituzioni coinvolte

Il “Progetto Crema Vita” è promosso dall’Azienda Ospedaliera “Ospedale Maggiore” di Crema attraverso la Direzione Generale e le Unità Operative di Cardiologia e di Rianimazione-Pronto Soccorso, dalla Croce Rossa Italiana Comitato di Crema, dalla Associazione di Volontariato “Un cuore per amico” e dal Panathlon International di Crema, con la collaborazione del Rotary Crema, del Rotary S. Marco, dei Club Lions di Crema, del Rotaract Terre Cremasche, del Leo Club Crema, del Soroptimist International, del Consorzio Crema Ricerche e della Fondazione Banca Popolare di Crema.

Si basa su una catena che coinvolge e correla, in una precisa sequenza temporale, l’Azienda Ospedaliera, il 118, le Istituzioni e tutte le forze del Volontariato per l’utilizzo da parte di personale non medico o sanitario “laico” di defibrillatori semiautomatici opportunamente dislocati nei punti strategici della città, come previsto dalla legge n.120 del 03.04.01 e successivamente dal Decreto Legge del 18 Marzo 2011.

In base a quanto sopra esposto, il progetto di defibrillazione precoce per il Comune di Crema prevede la dislocazione in punti strategici del territorio municipale di circa 14 (quattordici) DEA, la cui posizione viene riportata nella cartina allegata al progetto. La dislocazione dei DAE è la seguente:

1. Stadio Voltini
2. Palestra Bertoni
3. Piscina
4. Bocciodromo
5. Cinema Multisala
6. Teatro San Domenico
7. Ufficio Anagrafe Comune
8. Biblioteca
9. Università
10. Tribunale
11. Campo polisportivo Bertolotti di Santa Maria
12. Palestra Toffetti di Ombriano
13. Ipercoop
14. Mercato
15. Piazza Duomo
16. Piazza Garibaldi
17. Santa Maria
18. Quartiere Sabbioni Ombriano
19. Quartiere S. Stefano
20. Campo Dossena

Le postazioni fisse sono state scelte in modo da garantire per ciascun DAE una copertura territoriale adeguata. Inoltre, la maggior parte di queste postazioni sarà presidiata da volontari opportunamente addestrati, presenti durante le ore di affluenza della popolazione.

Sono previste inoltre 6 postazioni mobili (Carabinieri 3, Questura 1, Polizia Locale 1, Vigili del Fuoco 1).



Progetto “Crema vita” 2012-2013



Progetto “Crema vita” 2012-2013

Defibrillazione precoce – Tecnologia e gestione

I DAE telecontrollati, posti sul territorio sono costantemente sotto il controllo della centrale operativa di AREU 118.



Defibrillazione precoce – Tecnologia e gestione



LA CENTRALE AREU 118

Telecontrollo: la sicurezza del funzionamento del defibrillatore semiautomatico.



Invio automatico di SMS e e-mail in caso di:

1



Il defibrillatore è presente oppure rimosso?
Se rimosso, la centrale **può allertare i soccorsi!**



2



L'autotest automatico quotidiano è stato eseguito?
Se ci sono errori **avvisa il responsabile del centro** ed il tecnico!

3



La batteria ha almeno il 25% di carica residua?
Se è scarica, la centrale **avvisa il responsabile del centro!**



Conclusions



Fig. 1. Updated "Chain of Survival" with a 5th ring (Post-resuscitation Care).

