Public Access Defibrillation:

Stand der Dinge

Es besteht kein Interessenkonflikt

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Hintergrund

- plötzlicher Herz-/Kreislaufstillstand Hauptodesursache (400.000/a in Europa)
- 100 cardiac arrests / Jahr / 100.000 Einwohner

  Herlitz et al., Resuscitation 1999
- 3-8 % Überlebende nach cardiac arrest

  Nichol, Ann Emerg Med 1999
- zum Zeitpunkt der ersten EKG-Analyse 25-30 % Kammerflimmern

  Agarwal et al., Resuscitation 2009
- gelingt die Aufzeichnung direkt nach einem Kollaps: 59-65 % Kammerflimmern

  Weisfeldt et al., JACC 2010

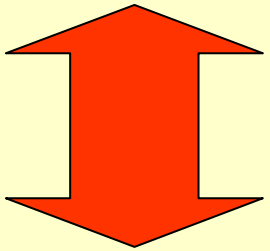
Hintergrund

- ✓ Defibrillation ist **die** Therapieoption bei plötzlichem Herztod
- ✓ Elektroschock innerhalb 30 Sek. bei Kammerflimmern: 98 % Wiederherstellung des Kreislaufs
- ✓ Elektroschock nach mehr als 7 Min.: 27 % Wiederherstellung
- ✓ deutlich erhöhte Überlebenswahrscheinlichkeit bei beobachtetem Herz-/Kreislaufstillstand

Capucci et al., Heart 2011

Anspruch und Wirklichkeit

(CPR +) Defibrillation soll schnellstmöglich (innerhalb von Minuten) durchgeführt werden



durchschnittliche Zeit bis zum Eintreffen des qualifizierten Rettungsdienstes in Bochum:
RTW --> 6:41 Min, NEF --> 8:52 Min

Die Lösung?

nicht auf den ausgerüsteten Rettungswagen warten, sondern den Defibrillator frühzeitiger zum Einsatzort bringen

Outcomes of Rapid Defibrillation by Security Officers after Cardiac Arrest in Casinos

AED + CPR-Schulung von 1350 Mitarbeitern in 32 Casinos
Zeitraum: 32 Monate

Überlebensrate:

- 74 % bei Defibrillation innerhalb von 3 Min. nach beobachtetem Kollaps
- 49 % bei Defibrillation später als 3 Min.

TABLE 1. CHARACTERISTICS OF SUBJECTS WITH CARDIAC ARREST IN CASINOS.*

CHARACTERISTIC	ALL CARDIAC ARRESTS (N=148)	WITNESSED ARRESTS WITH AN INITIAL RHYTHM OF VENTRICULAR FIBRILLATION (N=90)
Age — yr	64±12	65±11
Male sex — %	80	84
CPR administered before arrival of defibrillator — no. (%)	63 (43)	49 (54)
Interval from collapse to CPR — min	—†	2.9±2.8
Initial rhythm of ventricular fibrillation — no. (%)	105 (71)	90 (100)
Interval from collapse to attachment of defibrillator — min	—†	3.5±2.9
Interval from collapse to first defibrillation — min	—†	4.4±2.9
Interval from collapse to arrival of paramedics — min	—†	9.8±4.3
Survival to discharge from hospital — no. (%)	56 (38)	53 (59)

*Plus–minus values are means ±SD. CPR denotes cardiopulmonary resuscitation.

†Intervals from collapse to intervention could not be calculated for unwitnessed arrests.

Valenzuela et al., N Engl J Med 2000

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Public-Access Defibrillation and Survival after Out-of-Hospital Cardiac Arrest

The Public Access Defibrillation Trial Investigators*

- prospektive randomisierte Multicenter-Studie
- Ausbildung von 19.000 freiwilligen Laienhelfer u. a. in Einkaufszonen und Wohnanlagen
- CPR vs. CPR + AED

15 (14%)

30 (23%)

Table 4. Characteristics of the Definite Out-of-Hospital Cardiac Arrests.*

Characteristic	CPR Only (N=107)	CPR plus AED (N=128)	P Value†
Volunteer response activated — no. (%)‡	57 (53.8)	89 (69.5)	0.06
Bystander CPR — no. (%)§	62 (62.0)	81 (64.8)	0.55
Shock delivered with non-EMS AED — no. (%)	2 (1.9)	44 (34.4)	<0.001
Interval between call to EMS and first rhythm assessment — min ¶	8.7±5.5	6.0±4.7	<0.001
Ventricular fibrillation or ventricular tachycardia as first rhythm — no. (%)‖	43 (47.3)	71 (57.7)	0.66
Interval between call to EMS and arrival of EMS — min	5.6±3.4	5.7 (3.3)	0.63
Patient admitted to hospital — no. (%)	29 (27.1)	50 (39.1)	0.07

Survival After Application of Automatic External Defibrillators Before Arrival of the Emergency Medical System:

Evaluation in the Resuscitation Outcomes Consortium Population of 21 Million

- 13.769 cardiac arrests
- 4.403 CPR durch Ersthelfer ohne AED (32,0%)
- 289 AED vor Eintreffen des Rettungsdienstes (2,1%)

Überlebende

9%

24%

Survival to Hospital Discharge by Type of Location

	AED Applied Before EMS	Survival (%)	Bystander CPR, No AED Applied Before EMS	Survival (%)
Public	171	35	888	20
Street/highway	14	36	210	13
Public building	48	38	169	21
Place of recreation	41	49	135	24
Industrial place	18	22	54	15
Other public place	50	24	320	23
Private	117	9	3,510	6
Home residence	71	11	2,805	7
Farm/ranch	1	0	7	0
Residential institution	41	5	668	2
Other private place	4	0	30	10

Weisfeldt et al., JACC 2010

Tripling Survival From Sudden Cardiac Arrest Via Early Defibrillation Without Traditional Education in Cardiopulmonary Resuscitation

- Piacenza 173.000 Einwohner
- 39 AED's: Ambulanz- + Polizeiautos + feste Orte (nicht angewendet)
- 1.285 Laien: Erkennung Notfallsituation + AED
- Alarmierung Rettungsdienst + telefonisch Laienhelfer

TABLE 3. Time Intervals of Intervention

	PPV	EMS
Collapse to 118 phone call	NA	NA
118 Call to system activation, min	2.5±0.5*	1.0±0.5
EMS ambulance intervention		
118 Call to arrival at the scene of the event, min	4.8±[illegible].2	6.2±[illegible].3†
Arrival to defibrillation, s	40±13	NA

*Estimated.
†P=0.050.

TABLE 1. Comparison of Resuscitation and Survival Rate From Sudden Cardiac Arrest in Piacenza Progetto Vita vs Emergency Medical System–Treated Patients

	Overall	PPV	EMS	P (PPV vs EMS)
SCA, n (%)	354	143 (40.4)	211 (59.6)	<0.001
Resuscitation rate	34/354 (9.6)	19/143 (13.3)	15/211 (7.1)	0.053
Survival rate	22/354 (6.2)	15/143 (10.5)	7/211 (3.3)	0.006
Neurologically intact	17/354 (4.8)	12/143 (8.4)	5/211 (2.4)	0.009
Witnessed, n (%)	261/354 (73.7)	97/143 (67.8)	164/211 (77.7)	0.038
Resuscitation rate	34/261 (13.0)	19/97 ([illegible])	15/164 ([illegible])	0.015
Survival rate	22/261 (8.4)	15/97 (15.4)	7/164 (4.3)	0.002
Neurologically intact	17/261 (6.5)	12/97 ([illegible])	5/164 ([illegible])	0.003

Capucci et al., Circulation 2002

Nationwide Public-Access Defibrillation in Japan

- prospektive Beobachtung 2005 – 2007
- 312 319 Pat. mit Herz-/ Kreislaufstillstand
  12 631 Pat. mit beobacht. HK-Stillstand und VF
  462 Pat. (3,7%) mit Laienanwendung AED's

Table 1. Temporal Trends in the Cumulative Number of Public-Access Automated External Defibrillators (AEDs) and in the Incidence of Out-of-Hospital Cardiac Arrests in Japan.*

Variable	Total	2005	2006	2007
Public-access AEDs (no.)				
Total	88,265	9906	43,212	88,265
Per square kilometer of inhabited area	0.97	0.11	0.48	0.97
Per 100,000 population	69.0	7.8	33.8	69.0

AED-Nutzung 1,2%→6,2%

AED-Verfügbarkeit

< 1 AED / km²

≥ 4 AED's / km²

First shock with the use of a public-access AED					
No. of patients receiving shock	462	45	143	274	
Survival at 1 mo — no. of patients (%)	172 (37.2)	11 (24.4)	47 (32.9)	114 (41.6)	0.01
Survival at 1 mo with minimal neurologic impairment — no. of patients (%)	146 (31.6)	11 (24.4)	41 (28.7)	94 (34.3)	0.11

Kitamura et a., N Engl J Med 2011

A first city-wide early defibrillation project in a German city: 5-year results of the Bochum against sudden cardiac arrest study

- 155 AED's an öffentlichen Gebäuden, Firmen, Fitnesscentern, Feuerwehr
- Schulung von 6294 Laien in CPR + AED
- Beobachtungszeitraum 2004 - 2009

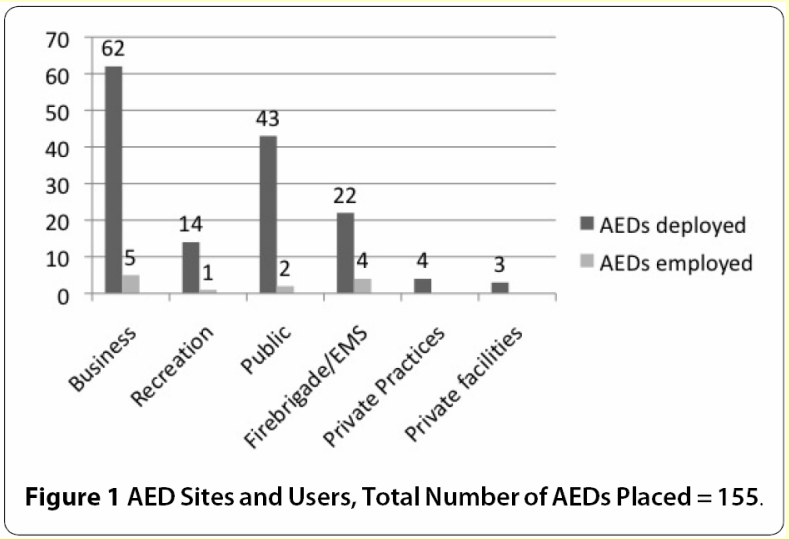


Figure 1 AED Sites and Users, Total Number of AEDs Placed = 155.

Table 2: AED use: frequency and outcome

Total AED use	12	Successful defibrillations	Survived
Defibrillations	7	4	2
No shock	5	-	4

Hanefeld, Scand J trauma resusc emerg med 2010

A first city-wide early defibrillation project in a German city: 5-year results of the Bochum against sudden cardiac arrest study

Table 1: Clinical outcome depending on underlying rhythm disturbance and type of resuscitation

Initial rhythm		Last rhythm documented by AED	CPR performed	Clinical course	Time (sec.) Switch-on to shock delivery
VF	VF	sVT	3 cycles	discharged from hospital	93
	VF	SR	-	discharged from hospital	59
	VF	VF (low-amplitude)	1 cycle	death in hospital	190
7	VF	VF	2 cycle	death in hospital	83
	VF (low-amplitude)	asystole	-	exitus letalis	49
	VF (low-amplitude)	asystole	-	exitus letalis	39
	VF	asystole	1 cycle	exitus letalis	149
non-malignant dysrhythmia	SR (bradycardia)	SR	-	discharged from hospital	No shock recommended
	SR	SR	1 cycle	discharged from hospital	No shock recommended
	AV junctional escape rhythm	idem	-	discharged from hospital	No shock recommended
	AV junctional escape rhythm	idem	-	discharged from hospital	No shock recommended
asystole	asystole	asystole	3 cycle	exitus letalis	No shock recommended

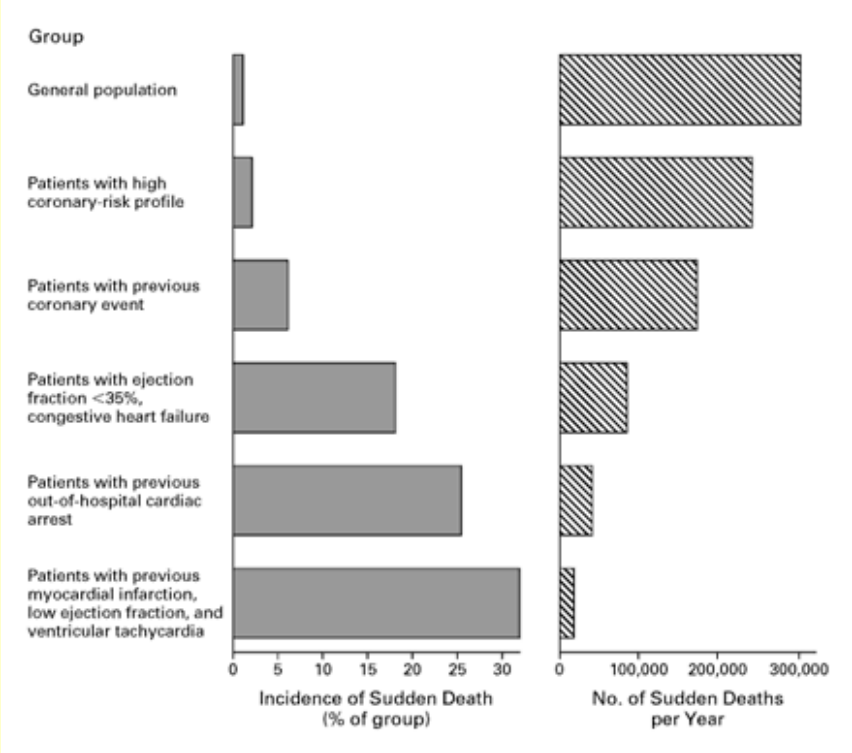
Table 3: Approximate estimation of costs: 5-year AED project

Purchase	2000 ∼ × 155 AEDs	310.000 ∼
Maintenance	100 ∼ × 155 AEDs	15.500 ∼
Training	20 ∼ × 6.924 individuals	125.880 ∼
Hotline, surveillance, evaluation (labour costs)	40.000 ∼ × 5 years	200.000 ∼
Total		**651.380 ∼**

Hanefeld, Scand J trauma resusc emerg med 2010

Das Problem

Es ist nicht vorhersehbar, wer einen Herz-/ Kreislaufstillstand erleidet, und wann und wo es passiert!



Huikuri et al., N Engl J Med 2001

Empfehlungen zur AED-Ortswahl

AHA
ein erwarteter cardiac arrest / 5 Jahre

ERC
ein erwarteter cardiac arrest / 2 Jahre

Flughäfen/große Bahnhöfe, Gefängnisse, Sportcenter, große Einkaufszentren, Bürogebäude mit Publikumsverkehr

Location of Cardiac Arrest in a City Center

Strategic Placement of Automated External Defibrillators in Public Locations

Lokalisation von 1274 cardiac arrests 1994 – 2005

AED's: 1,2 % der Fläche

19,5 % der cardiac arrests

AED's: 10,6 % der Fläche

66,8 % der cardiac arrests

ERC

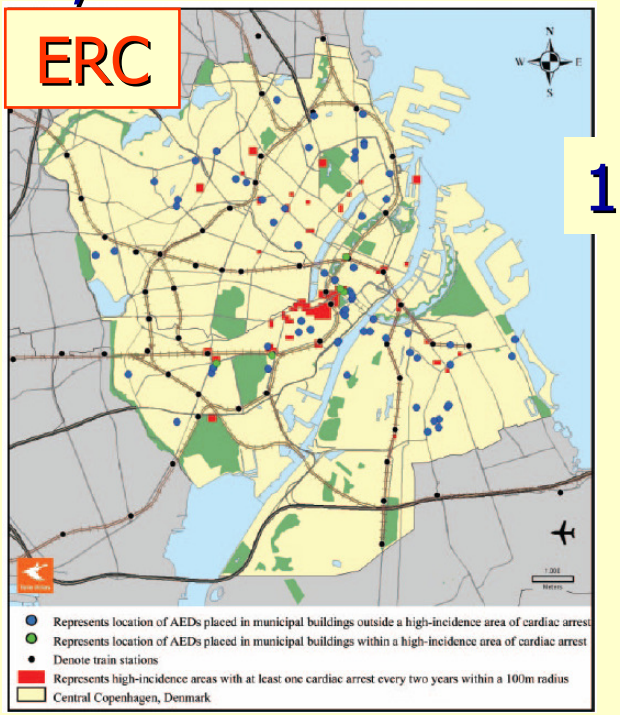


Figure 2. European Resuscitation Council guidelines for placement of AEDs. Copenhagen city map illustrates areas with at least 1 out-of-hospital cardiac arrest every 2 years in public and the actual placement of AEDs in municipal settings.

125 AED's vs 1104 AED'S

602 zusätzliche

cardiac arrests/11 Jahren

AHA

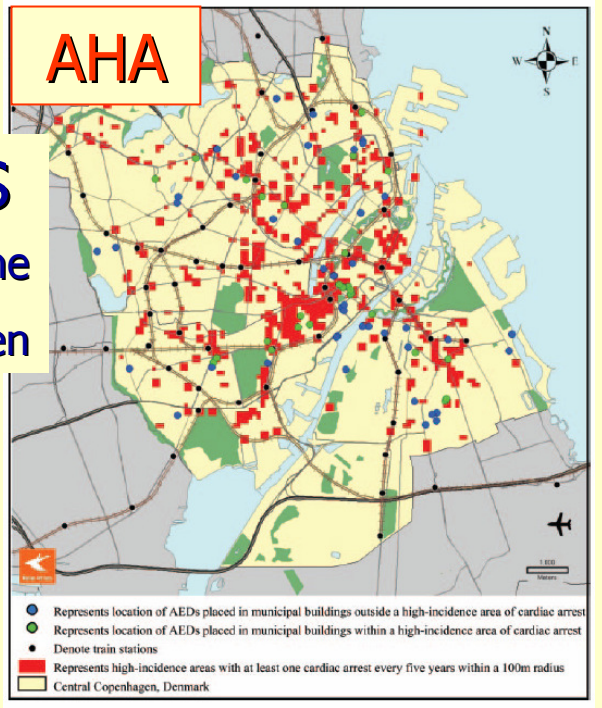
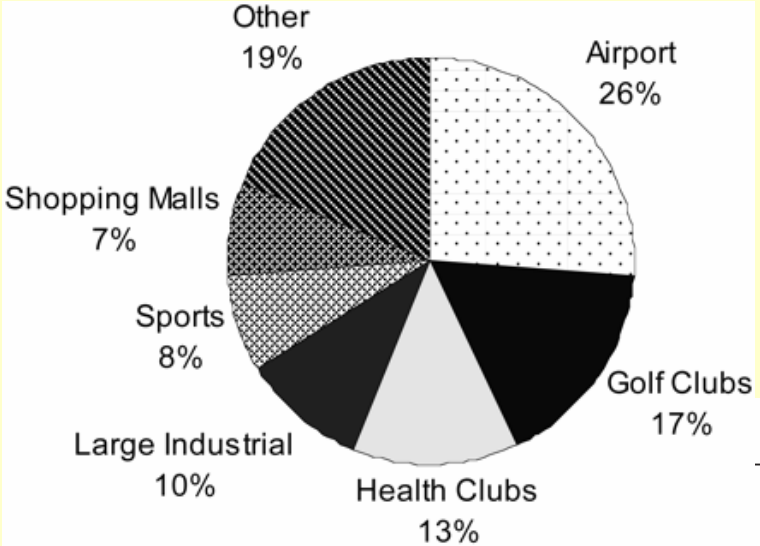


Figure 3. American Heart Association Guidelines for placement of AEDs. Copenhagen city map illustrates areas with at least 1 out-of-hospital cardiac arrest every 5 years in public and the actual placement of AEDs in municipal settings.

Public locations of SCA in Seattle, King County, Washington
1990-1994 (n=347)



Incidence of Cardiac Arrest per Site: Higher-Incidence Location Categories

Location Category	Arrests in 5 Years	Number of Sites	Annual Incidence Per Site, Average (Upper 95% CI)*	Number of Sites Required to Yield 1 Arrest per Year	Defibrillators Needed per Category
International airport	35	1	7 (12.5)	1	15
County jail	5	1	1 (2.4)	1	11
Large shopping mall	10	3	.6 (1.8)	2	27
Public sports venue	11	6	.4 (1.2)	3	24
Large industrial site	14	8	.4 (.8)	4	46
Golf course	23	47	.1 (.2)	5	47
Shelter	6	11	.1 (.3)	10	11
Ferries/train terminal	7	13	.1 (.3)	10	13
Health club/gym	18	47	.08 (.2)	12	47
Community/senior center	5	35	.03 (.07)	30	35
Total	134	172	N/A	78	276

*All lower 95% CIs are 0.

Becker et al., Circulation 1998

Public locations of SCA in Seattle, King County, Washington
1990-1994 (n=347)

TABLE 2. Incidence of Cardiac Arrest per Site: Lower-Incidence Location Categories

Location Category	Arrests in 5 Years	Number of Sites	Annual Incidence per Site, Average (Upper 95% CI)*	Number of Sites Required to Yield 1 Arrest per Year
Entertainment place	68	1245	.01 (.02)	100
Hotel/motel	22	377	.01 (.03)	100
Private ambulance	3	106	.03 (.07)	167
Bus	31	1138	.005 (.01)	200
Bar/tavern	11	413	.005 (.01)	200
Civic/fraternal	7	316	.004 (.01)	250
Government office	6	448	.003 (.005)	333
Nonretail business	48	33 662	.003 (.004)	333
Industrial manufacturing	40	3304	.002 (.004)	500
School/church	21	1943	.002 (.004)	500
Restaurant	36	4109	.002 (.004)	500
Retail store	47	17 390	.0005 (.001)	2000
Construction site	7	12 606	.0001 (.0003)	10 000
Vehicles	168	1 322 040	.0001 (.00003)	10 000
Outdoors	385	N/A	N/A	N/A
Total	900	N/A	N/A	N/A

*All lower 95% CIs are 0.

Becker et al., Circulation 1998

Errechnete Kosten der Public Access Defibrillation pro gewonnenes Lebensjahr

Potential Cost Effectiveness of Defibrillation in Various Public Settings

Location Category	
International airport	$ 55 200
Golf course	$130 900
Public sports venue	$136 500
County jail	$159 800
Health club/gym	$153 900
Large shopping mall	$162 100
Large industrial site	$162 500
Community center	$378 600

Nichol et al., Circulation 2004

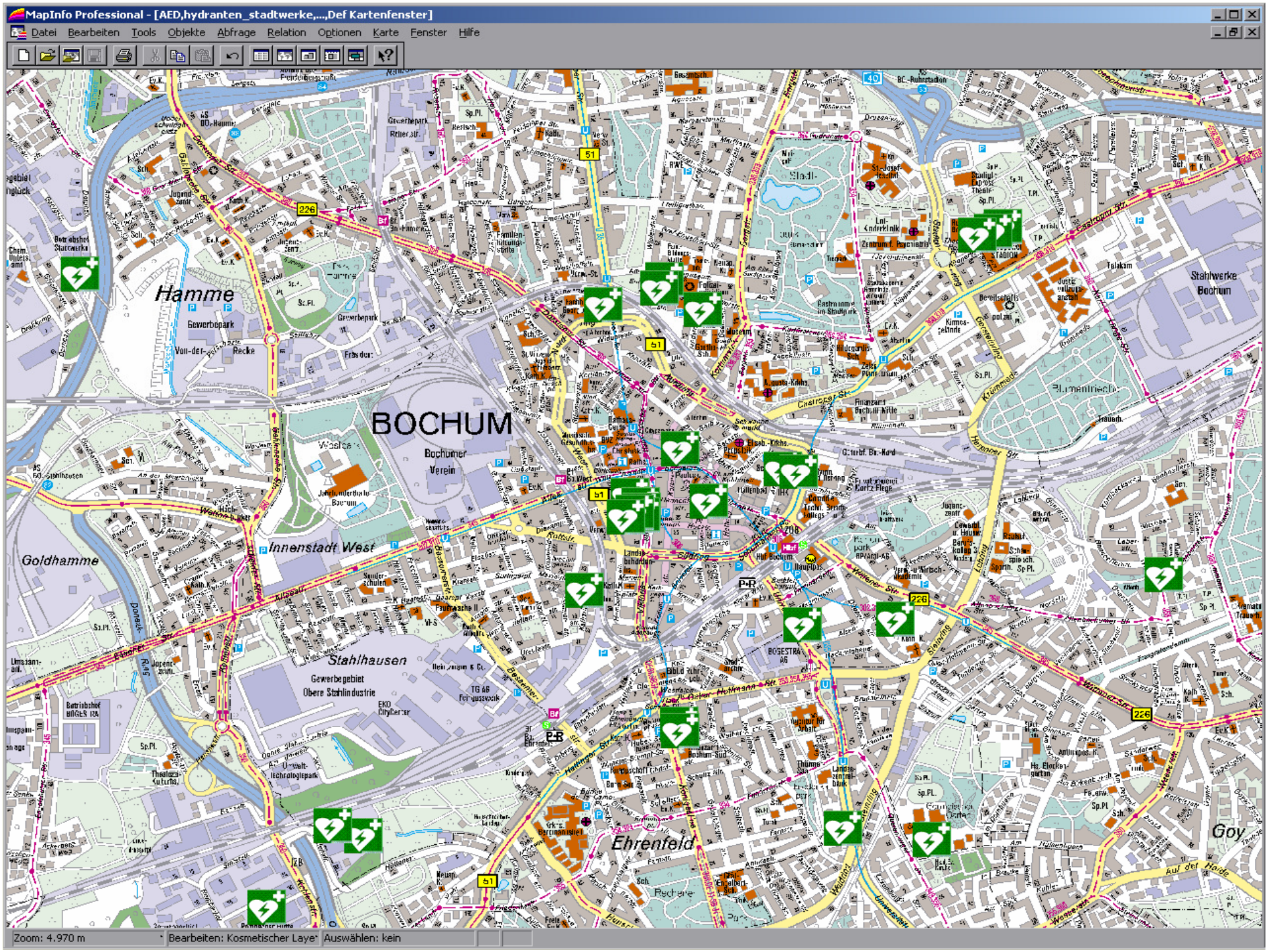
Schulungen

Table 2 AED training should be as simple as possible: a summarised scheme of training according to the category of volunteers and students' age

Primary schools	1 h	Education in emergency calling and 'game' with the use of AED
Secondary schools	1 h	Video auto-training 2 min duration with practice on a mannequin
Police—firemen	2 h	Video training and practice (CPR if they are on duty)
General public	15 min	Video in public places, on TV and cinemas, and in hospital videos
Lay responders	1 h	Group of 12—15 persons, with video support and practice
Sport facilities	30 min	Auto training with video and simple practice afterwards; 2 min video in sport places
Officers at school and public office	30 min	One instructor with video support

AED, automated external defibrillator; CPR, cardiopulmonary resuscitation.

Capucci et al., Heart 2011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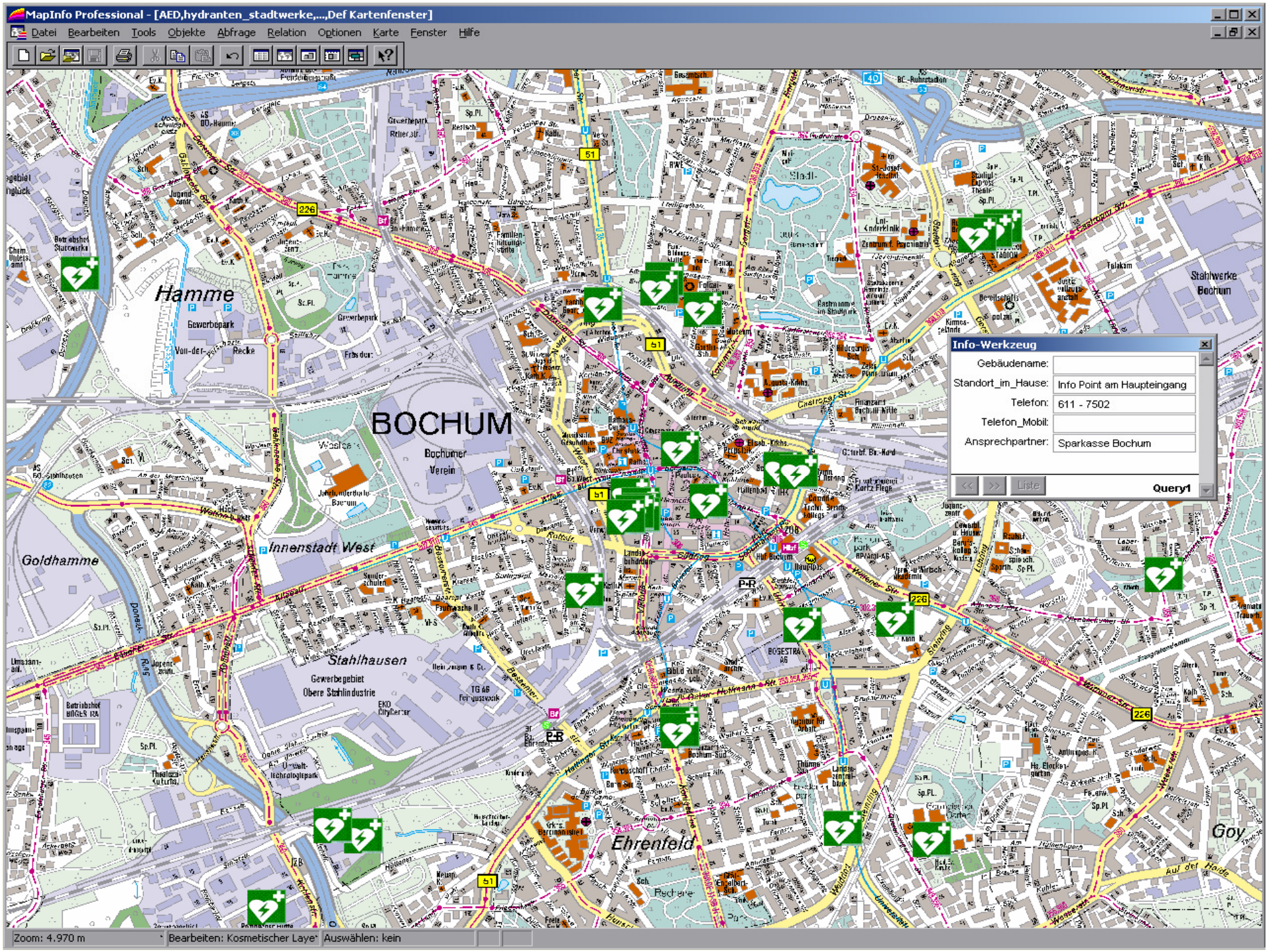
Ehrenfeld
Stahlwerke Bochum
Goy
Zoom: 4.970 m
Bearbeiten: Kosmetischer Laye
Auswählen: kein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Auswählen: kein

Public Access Defibrillation: Stand der Dinge

- strukturierte PAD-Programme führen zu einer höheren Überlebensrate
- Die unstrukturierte Aufhängung von AED's in Städten ist nicht zielführend
- Die Einbindung in das örtliche Rettungsdienstsystem ist obligat; die Leitstellenanbindung ist zwingend
- Es bedarf einer breiten Aufklärung der Bevölkerung und einer gezielten Schulung für vor Ort (beruflich) tätige Laien (ggf. auch besonders engagierte Personen)
- AED-Einführung und CPR-Schulung können knapp gehalten werden; die Wiederholung ist wichtig

Public Access Defibrillation:

Stand der Dinge

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