

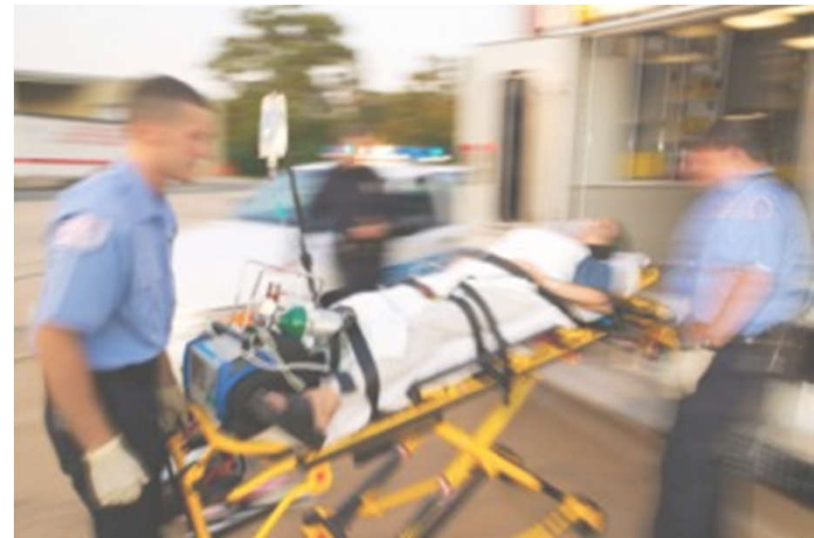
# A Prediction Tool for Initial Survivors of out-of- Hospital Cardiac Arrest

S. Aschauer, A. Schober, T. Uray, A. Spiel, C. Wallmueller, M. Stoeckl, P. Stratil,  
D. Hoerbuerger, C. Testori, C. Weiser, A. Erdogmus, A. Laggner, G. Dorffner, F. Sterz,

# background

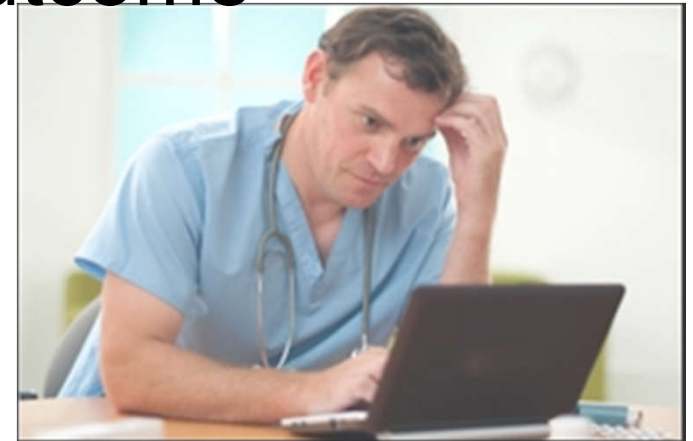
## out of hospital cardiac arrest (OOHCA)

- major health problem
- 500.000 patients in United States and Europe /year
- overall mortality: 8% - 11%



# background

- OOHCA has a very uncertain outcome
- no valid outcome scoring system
- problem in giving reliable outcome estimation
- delicate decisions only based up on experience and gut feeling



# aim

- to **assess** the **predictability** of outcome after OOHCA, based on a number of observational variables
- to **identify variables** with **high predictive power**
- to assess whether a **multivariate** approach is superior to a **univariate** one
- to derive a OOHCA **outcome prediction score tool**



# benefit

- improvement of the predictability of patient's survival would be of major **medical** and **socioeconomic interest**.
- valid outcome estimation **could facilitate decision**-making for persons in authority and could **save medical resources**

# methods

- based on a **cardiac arrest-registry with > 4000 patients** which were resuscitated from OOHCA and which were admitted to the Department of Emergency Medicine at a large University Hospital
- **multivariate logistic regression** was applied on 20 **variables** before ROSC deemed to have **high predictive power**

# methods

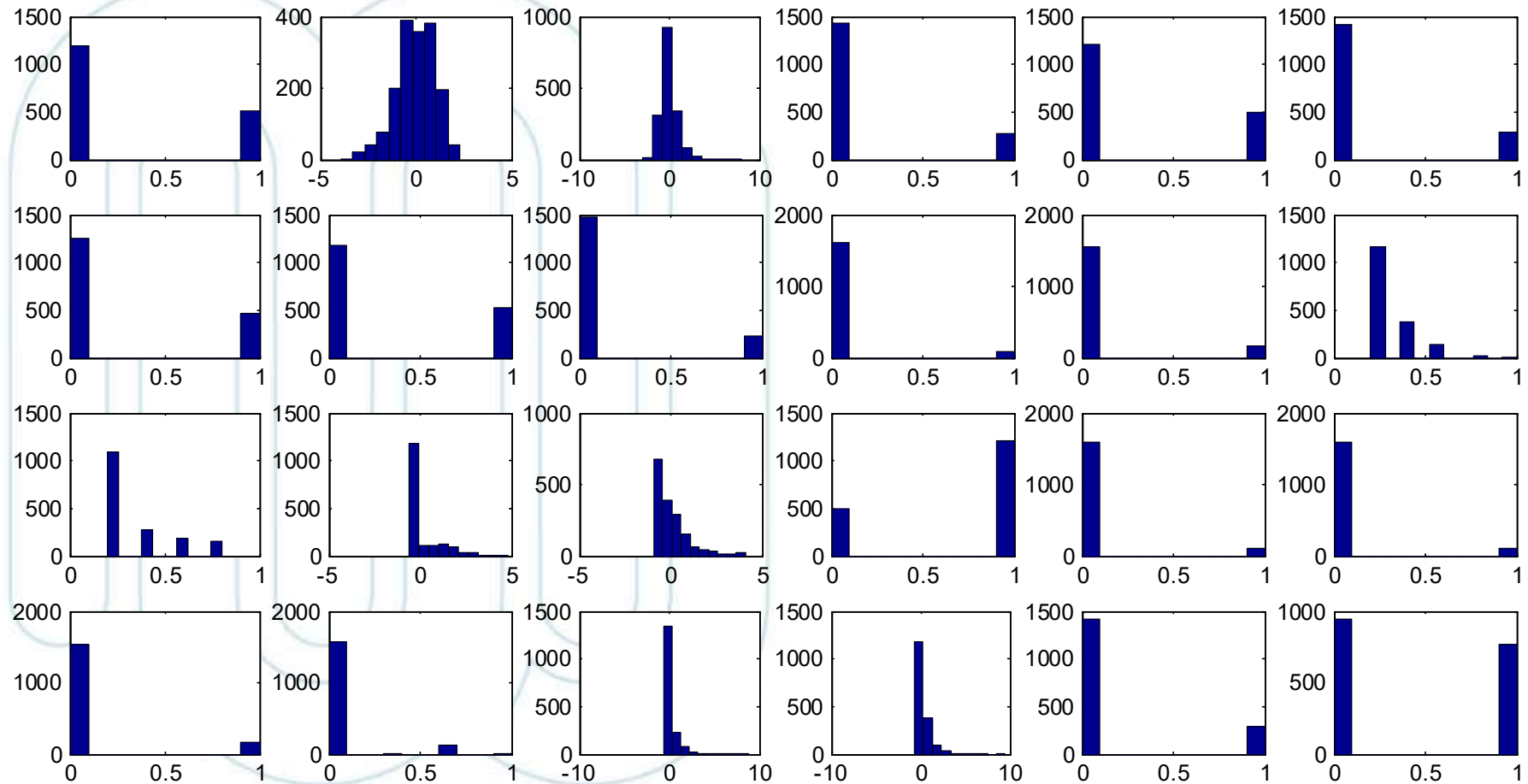
- the framework of **machine learning** was chosen
- a **10-fold cross-validation** was done for reliable estimates and confidence intervals
- main performance parameter was the **area under the ROC curve (AUC)**

# variables

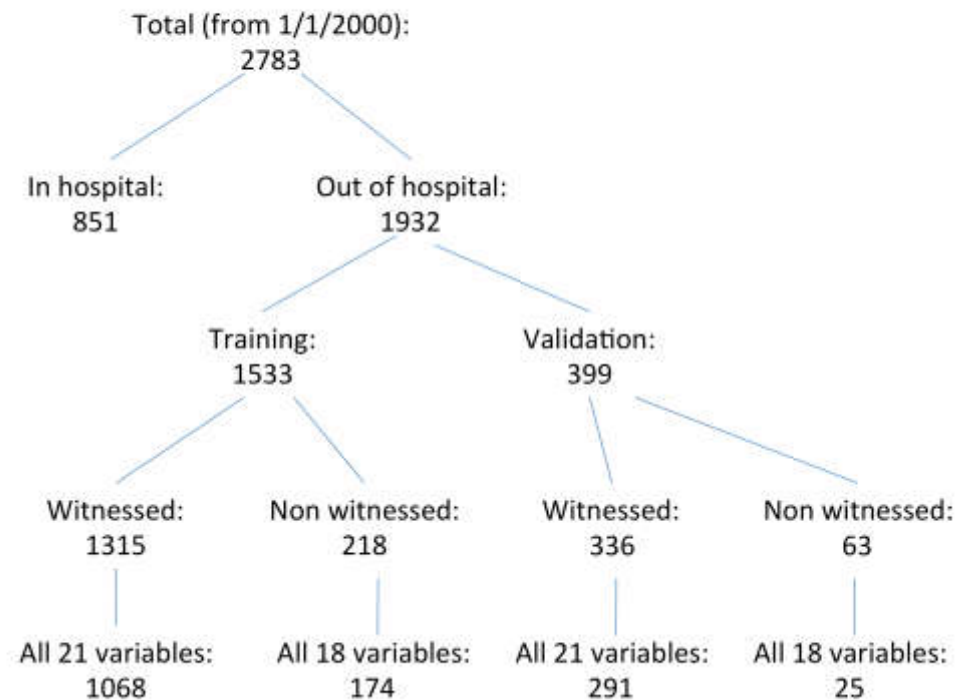
<i>Variable name</i>	<i>Description</i>	<i>Value</i>	<i>Scale</i>
<b>sex</b>	Sex of the patient	Male=0, Female=1	binary
<b>age</b>	Age of the patient	In years, at the time of cardiac arrest	metric
<b>bmi</b>	Body Mass Index	Weight (kg) / Size (m) Squared	metric
<b>diabetes</b>	Previous diagnosis of diabetes	Diabetes = 1, no diabetes = 0	binary
<b>smoker</b>	Patient is a smoker	Smoker=1, nonsmoker=0	binary
<b>myocinfarct</b>	Patient previously had a myocardial infarction	Infarction=1, no infarction=0	binary
<b>khk</b>	Previous diagnosis of Coronary Artery Disease	CAD=1, no CAD=0	binary
<b>hypertension</b>	Previous diagnosis of hypertension	Hypertension=1, no hypertension=0	binary
<b>heartfail</b>	Previous diagnosis of heart failure	Heart failure=1, no heart failure=0	binary
<b>cvi</b>	Previous diagnosis of chronic venous insufficiency	CVI=1, no CVI=0	binary
<b>copd</b>	Previous diagnosis of chronic obstructive pulmonary disease	COPD=1, no COPD=0	binary
<b>opcpre</b>	OPC score prior to cardiac arrest	Score 1 to 5	ordinal, treated as metric
<b>nyh5pre</b>	NYH5 score prior to cardiac arrest	Score 1 to 5	ordinal, treated as metric
<b>noflow</b>	Minutes between cardiac arrest and first aid (length of "no flow" time)	in minutes	metric
<b>min2srosc</b>	Minutes between cardiac arrest and SROSC	in minutes	metric
<b>cause</b>	Main cause of cardiac arrest	Cardiac=1, non-cardiac=0	binary
<b>firstaid</b>	First aid performed by physician, family member, paramedic or layman	Physician=1, non-Physician=0	binary
<b>nodefi</b>	Number of defibrillation shots	Count of shots	metric
<b>adrenaline</b>	Amount of adrenaline applied	Total amount (in ...)	metric
<b>shockable</b>	Shockability of rhythm in first defibrillation	Shockable=1, non-shockable=0	binary
<b>defireaction</b>	Reaction to the first defibrillation	Not shockable=0, shockable and VT/VF (as reaction to first defi)=1, shockable and PEA=2, shockable+Asystole=3, shockable+SR/RHY/SVES/VES/AVES+ no pulse=4, shockable+pulse=5	ordinal, treated as metric



# Initial variables, histograms



# Data sets



# witnessed



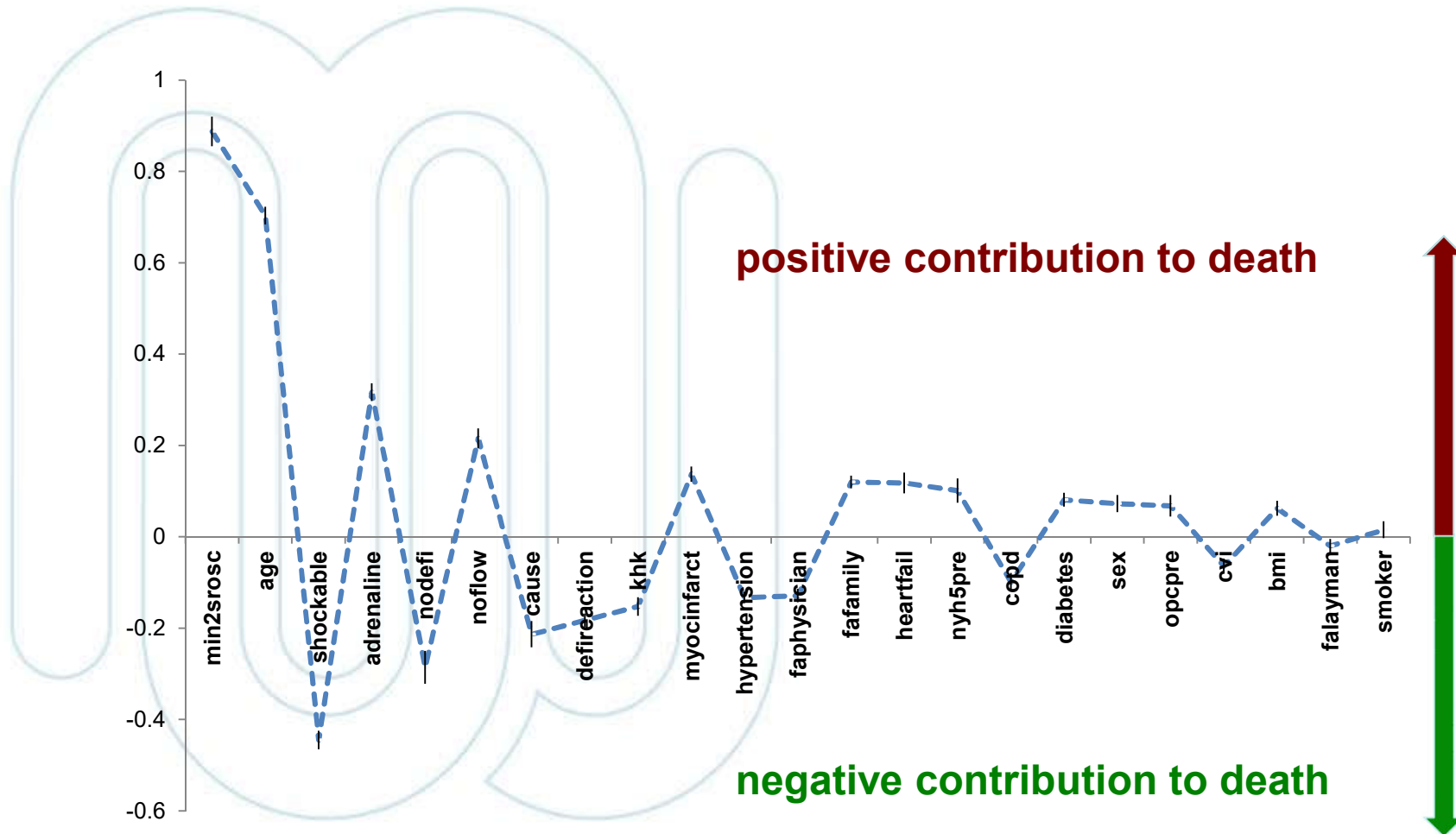
Trainingset	median	25% percentile	75% percentile	Percent 1	Percent 0
sex				27.53%	72.47%
age	59	49	69	0	0
bmi	26.12	23.88	29.22	0	0
diabetes				16.20%	83.80%
smoker				30.90%	69.10%
myocinfarct				12.92%	87.08%
cad				21.91%	78.09%
hypertension				32.21%	67.79%
heartfail				11.05%	88.95%
cvi				5.99%	94.01%
copd				9.74%	90.26%
opcpre	1	1	1		
nyh5pre	1	1	2		
noflow	1	0	6.5		
min2srosc	20	10	30		
cause				69.76%	30.24%
firstaid				34.18%	65.82%
nodefi	2	0	4		
adrenaline	2	0	4		
defireaction	1	0	2		
shockable				59.83%	40.17%
cpc30d	3	1	5		
mortality				39.89%	60.11%
Testset	median	25% percentile	75% percentile	Percent 1	Percent 0
sex				27.84%	72.17%
age	61	50	71		
bmi	26.23	24.11	29.41		
diabetes				20.62%	79.38%
smoker				31.62%	68.39%
myocinfarct				14.09%	85.91%
cad				24.74%	75.26%
hypertension				41.92%	58.08%
heartfail				14.78%	85.22%
cvi				4.81%	95.19%
copd				6.53%	93.47%
opcpre	1	1	2		
nyh5pre	1	1	2		
noflow	1	0	5		
min2srosc	19	12	32		
cause				62.54%	37.46%
firstaid				49.49%	50.52%
nodefi	1	0	3		
adrenaline	1	0	3		
defireaction	1	0	2		
shockable				54.30%	45.70%
cpc30d	3	1	5		
mortality				42.27%	57.73%

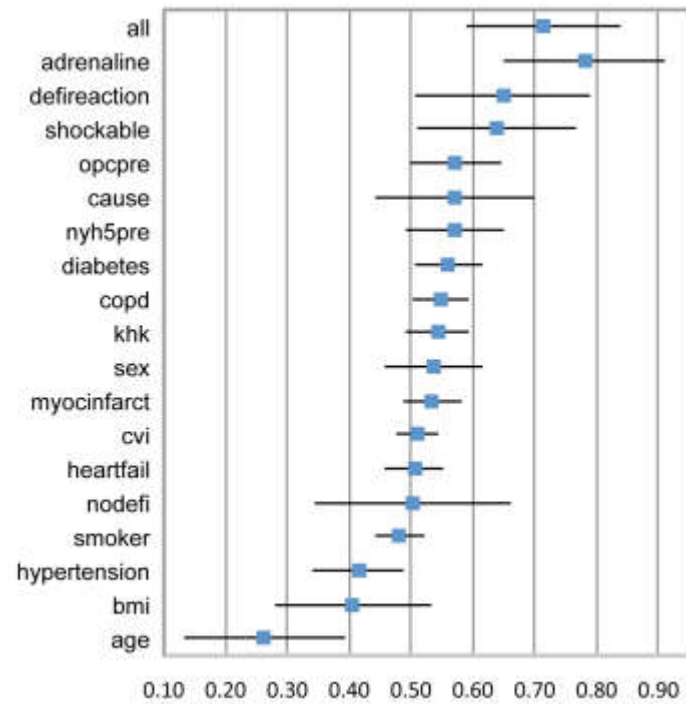
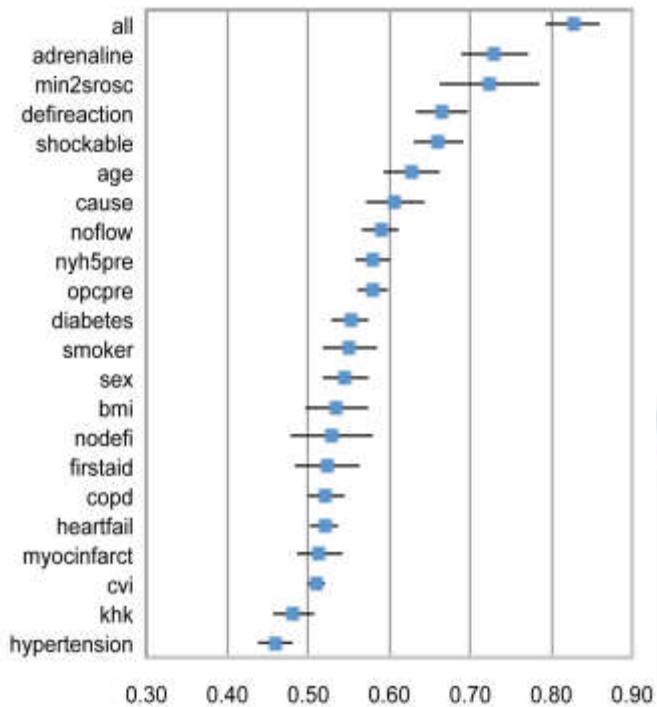
# Non-witnessed



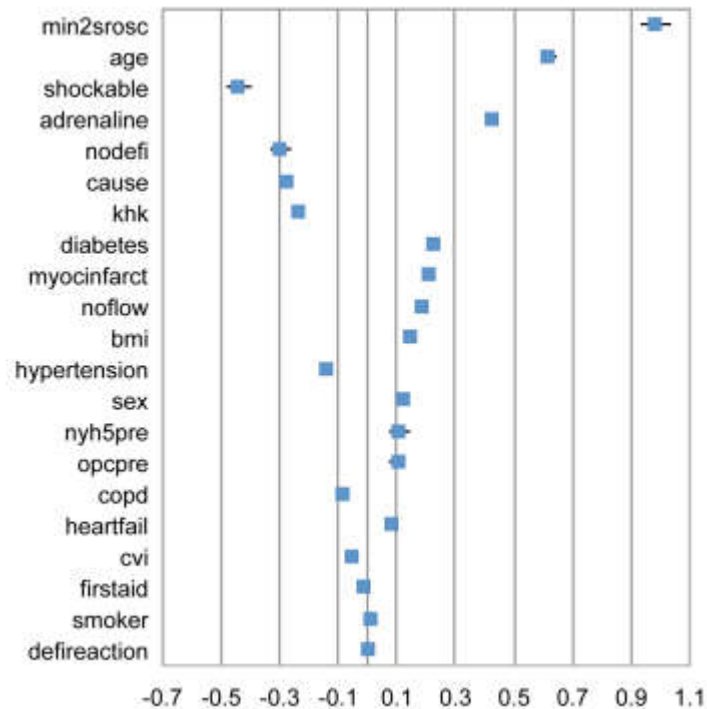
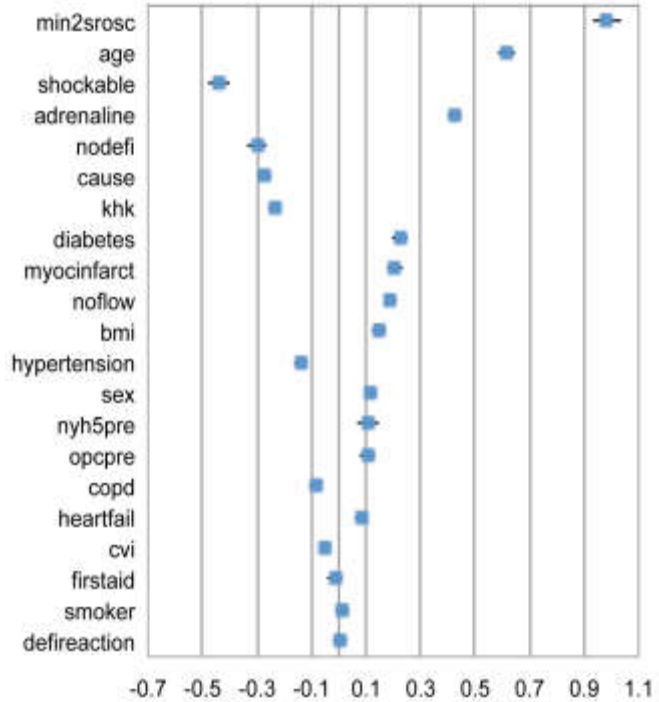
Trainingset	median	25% percentile	75% percentile	Percent 1	Percent 0
sex				30.46%	69.54%
age	56	41	68		
bmi	25.94	22.86	28.72		
diabetes				14.37%	85.63%
smoker				27.01%	72.99%
myocinfarct				9.77%	90.23%
khk				16.09%	83.91%
hypertension				26.44%	73.56%
heartfail				10.92%	89.08%
cvi				4.02%	95.98%
copd				8.62%	91.38%
opcpre	1	1	1		
nyh5pre	1	1	1		
cause				43.68%	56.32%
nodefi	1	0	4		
adrenaline	4	2	6.5		
defireaction	0	0	1		
shockable				36.78%	63.22%
cpc30d	5	5	5		
mortality				76.44%	23.56%
Testset	median	25% percentile	75% percentile	Percent 1	Percent 0
sex				20.00%	80.00%
age	54	44.5	64.25		
bmi	26.23	23.32	28.18		
diabetes				0.00%	100.00%
smoker				32.00%	68.00%
myocinfarct				4.00%	96.00%
khk				12.00%	88.00%
hypertension				44.00%	56.00%
heartfail				4.00%	96.00%
cvi				4.00%	96.00%
copd				16.00%	84.00%
opcpre	1	1	1		
nyh5pre	1	1	1		
cause				60.00%	40.00%
nodefi	1	0	6.25		
adrenaline	4	2	8		
defireaction	1	0	1		
shockable				60.00%	40.00%
cpc30d	5	1.75	5		
mortality				68.00%	32.00%

# results



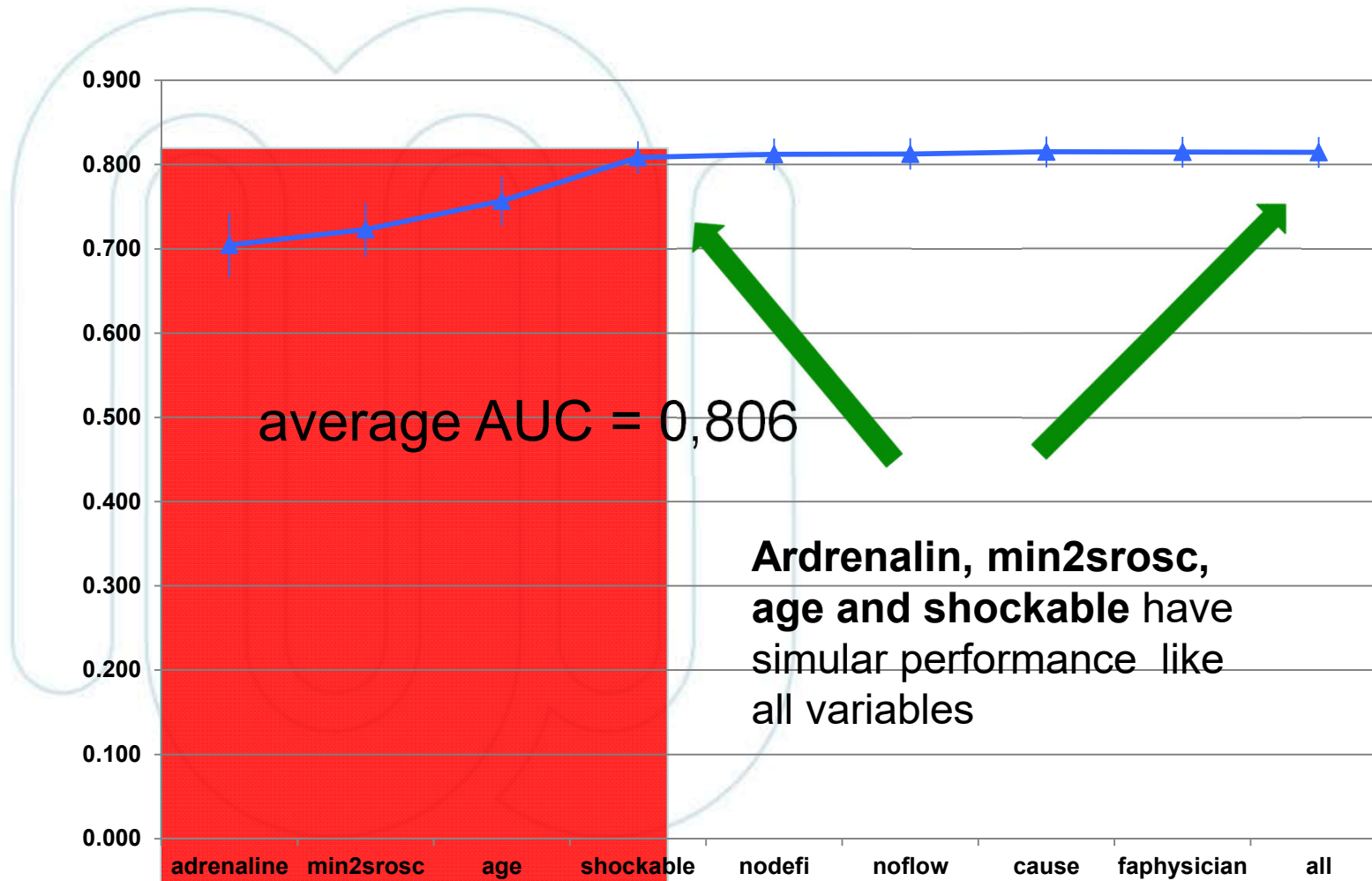


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# results



# Score

$$Y=0.0284*\text{min2srosc}+0.0355*\text{age}-1.4608*\text{shockable}+0.1528*\text{adrenaline}$$

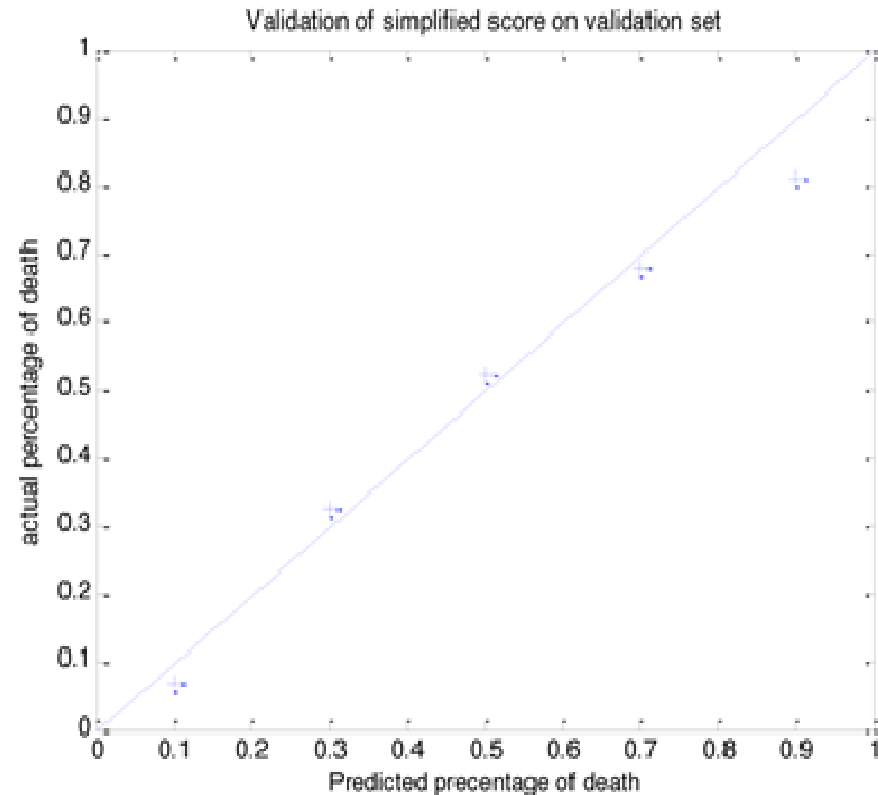
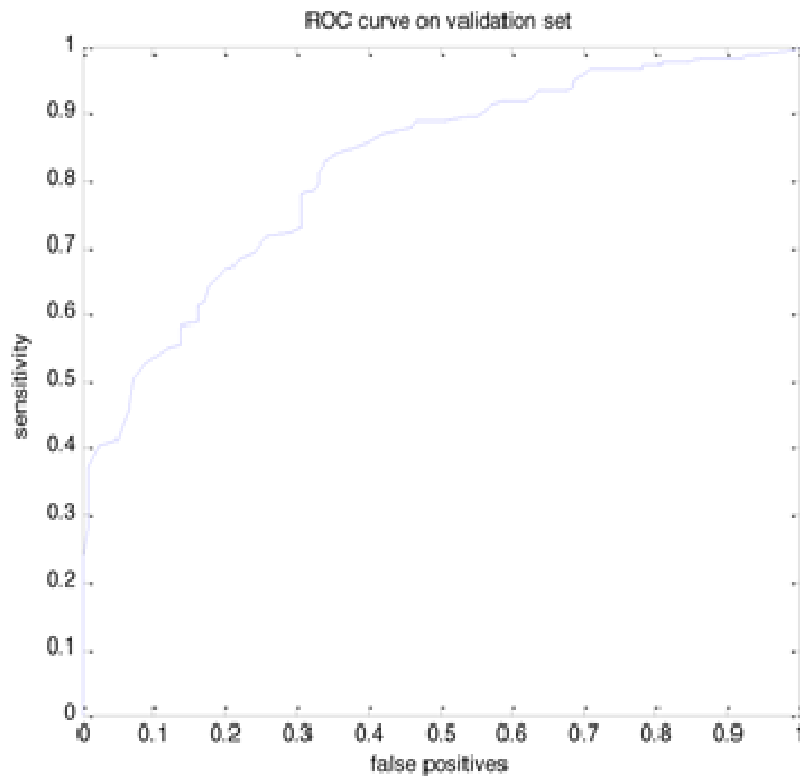
if Y < 1.3320	then	p(mortality)=0.1
else if Y < 2.3129	then	p(mortality)=0.3
else if Y < 3.1238	then	p(mortality)=0.5
else if Y < 4.1046	then	p(mortality)=0.7
else		p(mortality)=0.9



# Simplified score

Predictor	Points	Predictor	Points
<b>1. Age group</b>		<b>3. Minutes until SROSC</b>	
>80	32	>100min	35
>70	27	>50min	21
>50	23	>40min	13
>60	20	>30min	10
>40	16	>20min	7
≤40	11	>10min	4
<b>2. Adrenalin administered</b>		>0min	1
>10mg	24	0min	0
>5mg	12	<b>4. Shockable rhythm?</b>	
>4mg	7	Yes	-15
>3mg	5	No	0
>2mg	4	<b>Total score</b>	
>1mg	2		
>0mg	1		
0mg	0		
<b>Total score</b>		<b>Probability for mortality</b>	
<13		10%	
13-22		30%	
23-30		50%	
31-40		70%	
>40		90%	

# predicted mortality



# conclusion

- current results can improve OOHCA outcome predictability
- 4 variables are as good as all 20 variables for outcome estimation
- results can serve as base for a future simple OOHCA survival prediction score