

**RESULTS OF OUT-OF-HOSPITAL
CARDIAC ARREST AND
REGIONALIZATION STRATEGY FOR
IMPROVING THE OUTCOMES IN KOREA**

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Conflict of Interest

- ▣ Most of contents of this presentation is on the basis of the Report from *Cardio-Vascular Disease Surveillance (CaVaS) project*, which was financially supported by the Korean Centers for Disease Control and Prevention since 2008.
- ▣ No conflict of interest

Contents

- ▣ Background of a nationwide surveillance on SCD
- ▣ Study materials and methods
 - Data collection process: *Cardio-Vascular Disease Surveillance (CaVaS) project*
- ▣ Results
 - Demographic findings
 - Main issues: Community-EMS-ED-Hospital
 - Regionalization Issue: case volume and transport time
- ▣ Limitation and Summary

**BACKGROUND OF A
NATIONWIDE SURVEILLANCE
ON SCD**

Sudden Cardiac Death

- ▣ “Unexpected” due to cardiac cause and heralded by abrupt loss of consciousness 1 hour or less after the onset of acute symptoms
- ▣ Excluding 1) expected death due to chronic disease, 2) non-cardiac cause
- ▣ Divided with two categories
 - By In-hospital cardiac arrest
 - By Out-of-hospital cardiac arrest (OHCA)

Sudden Cardiac Death

- ▣ All kinds of cause of death: 244,800 (2008)
 - By traffic accident: 6,166 (2006)
 - By suicide :12,174 (2008)
 - By lung cancer: 12,587 (2003)
- ▣ Sudden Cardiac Death in Korea: ?
 - By OHCA?

EMS-assessed OHCA

- ▣ Most of SCDs are transported by ambulance
 - Inclusion criteria
 - ▣ OHCA transported by EMS
- ▣ Hospital based data
 - Various in inclusion criteria by hospitals
 - Different denominator
 - Too difficult to compare those data
- ▣ EMS-assessed
 - Transported by Ambulance
 - Treated or not treated cases

Goal of CAVAS project

- ▣ To know in Korea
 - Population-based incidence
 - Community performance
 - EMS performance
 - Hospital performance
 - Outcomes
 - Association between risk factor and the main outcomes

Chain of Survival



Community level

EMS level

Hospital level

Community-EMS-Hospital performance

- ▣ Community
 - witness arrest and bystander CPR
 - Bystander defibrillation
- ▣ EMS
 - Early response time/ Transport time
 - EMS defibrillation
 - Quality CPR
- ▣ ED-Hospital
 - Optimal critical care
 - Therapeutic hypothermia

STUDY MATERIALS AND METHODS

Study setting

- ▣ Fire department-based (119)
- ▣ Single tiered intermediate service level
 - Basic life support, AED, and IV, LMA, ETI
- ▣ 16 Regional FDs
- ▣ 1,255 Ambulance station (2007)
- ▣ 5,310 EMS providers (level 1 and level 2 and drivers)
- ▣ 800-900 hospitals including 460 Emergency departments (level 1 , 2, and 3)

Study population

- ▣ Study period
- ▣ 2006-2008 (finished), 2009-2010 (on-going)
 - 1st step
 - ▣ Extracted OHCA candidates from ambulance run sheet database when a chief complaint was cardiac arrest or respiratory arrest
 - ▣ Contains community or EMS performance indicators
 - 2nd step
 - ▣ Reviewed hospital records by medical record reviewers
 - ▣ To confirm the case and know the hospital outcomes
 - ▣ Collect hospital performance indicators

Data process

- ▣ Inclusion
- ▣ Confirmed OHCA in hospital record
- ▣ Exclusion for analysis
 - Unknown outcomes
 - Transfer to other hospital

Outcomes

- ▣ Population-based incidence
- ▣ 16 provinces
- ▣ Age-gender standardized

Risk factors

- ▣ Individual
 - Age, sex, urbanization, SES
- ▣ Community performance
 - Bystander CPR or Witnessed
- ▣ EMS performance
 - Response time
 - Transport time
 - EMS defibrillation or first ECG
- ▣ Hospital performance
 - CPR case volume, optimal intervention and hypothermia


Outcomes

- ▣ Return of Spontaneous Circulation (ROSC)
- ▣ Survival to admission
- ▣ Survival to discharge

RESULTS

EMS-assessed OHCA

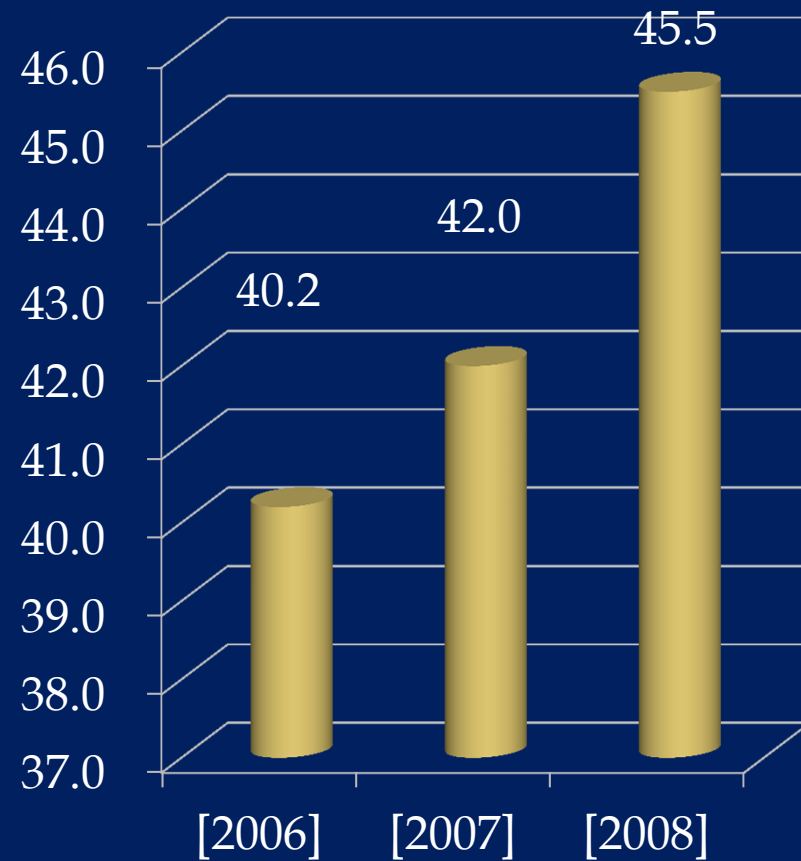
Year	EMS run sheet	Successful hospital Record Review		Confirmed OHCA	
	N	N	%	N	%
Total	39,833	36,724	92.2	34,408	86.4
2006	19,477	17,750	91.1	16,345	83.9
2007	20,356	18,974	93.2	18,063	88.7
2008	21,905	20,520	93.7	19,707	90.0

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- 1) Closed hospital
 - 2) Refusal for hospital record review
 - 3) Lack of medical documentation

Demographics

▣ OHCA with any etiology transported by FD ambulances

- 19,477 (2006)
- 20,356 (2007)
- 21,905 (2008)



Standardized Incidence Rate Per 100,000

N=47 million
Total population

N=19,045 [2006-2007]
EMS-assessed non-traumatic OHCA

N=3,987
Resuscitation
Not-attempt

N=15,058 (79.0%)
Resuscitation attempt

N=594
Witnessed and shockable

358 ROSC (59.0%)
280 Survival to admission (47.0%)
122 Survival to discharge (20.4%)
58 Good CPC (9.7%)

3,096 ROSC (20.6%)
2,237 Survival to admission (14.9%)
524 Survival to discharge (3.5%)
161 Good CPC (1.1%)

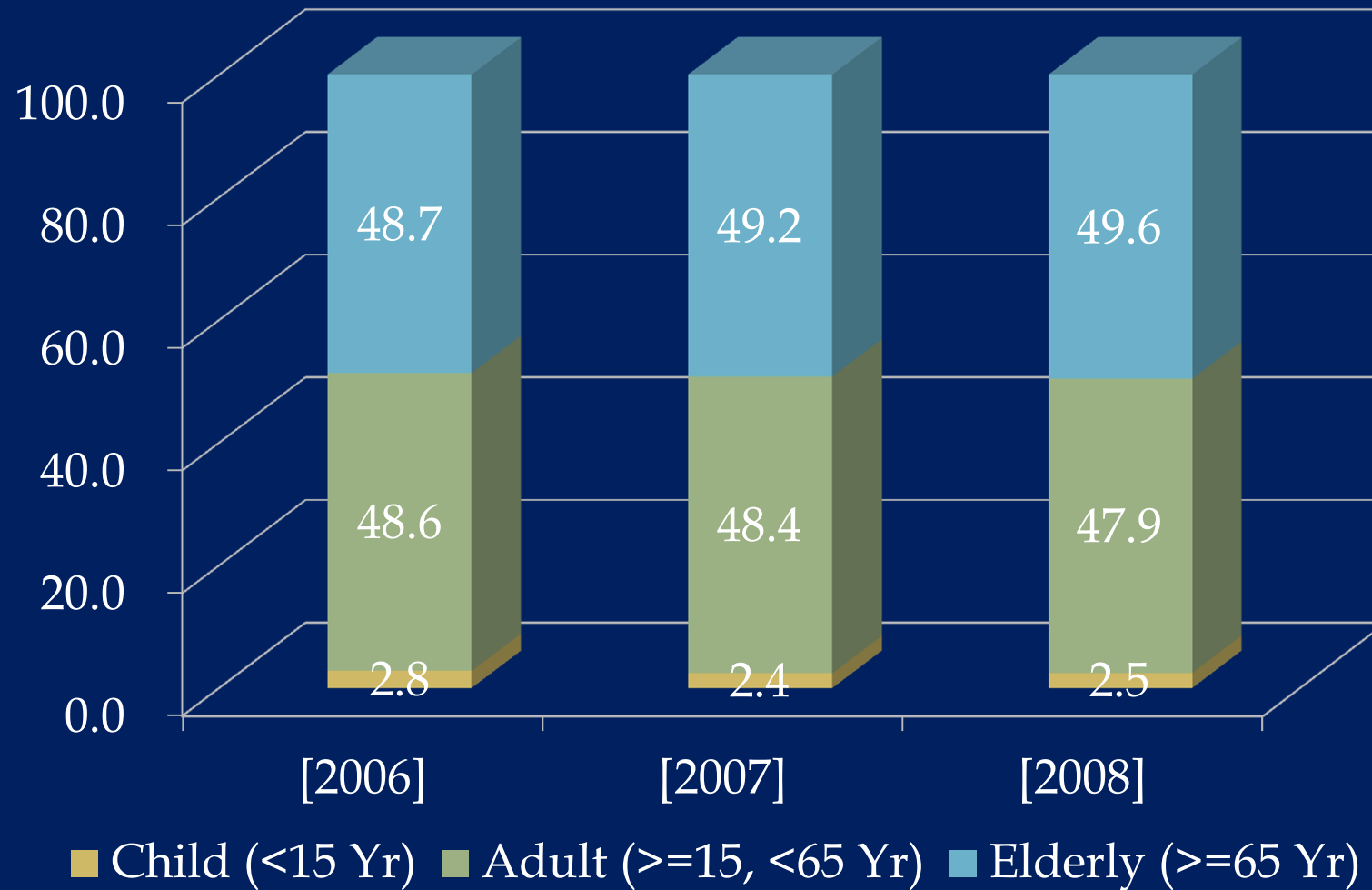
From Ahn KO, Shin SD, et al, Resuscitation 2010

Standardized Incidence Rate of OHCA with cardiac origin



From Ahn KO, Shin SD, et al, Resuscitation 2010

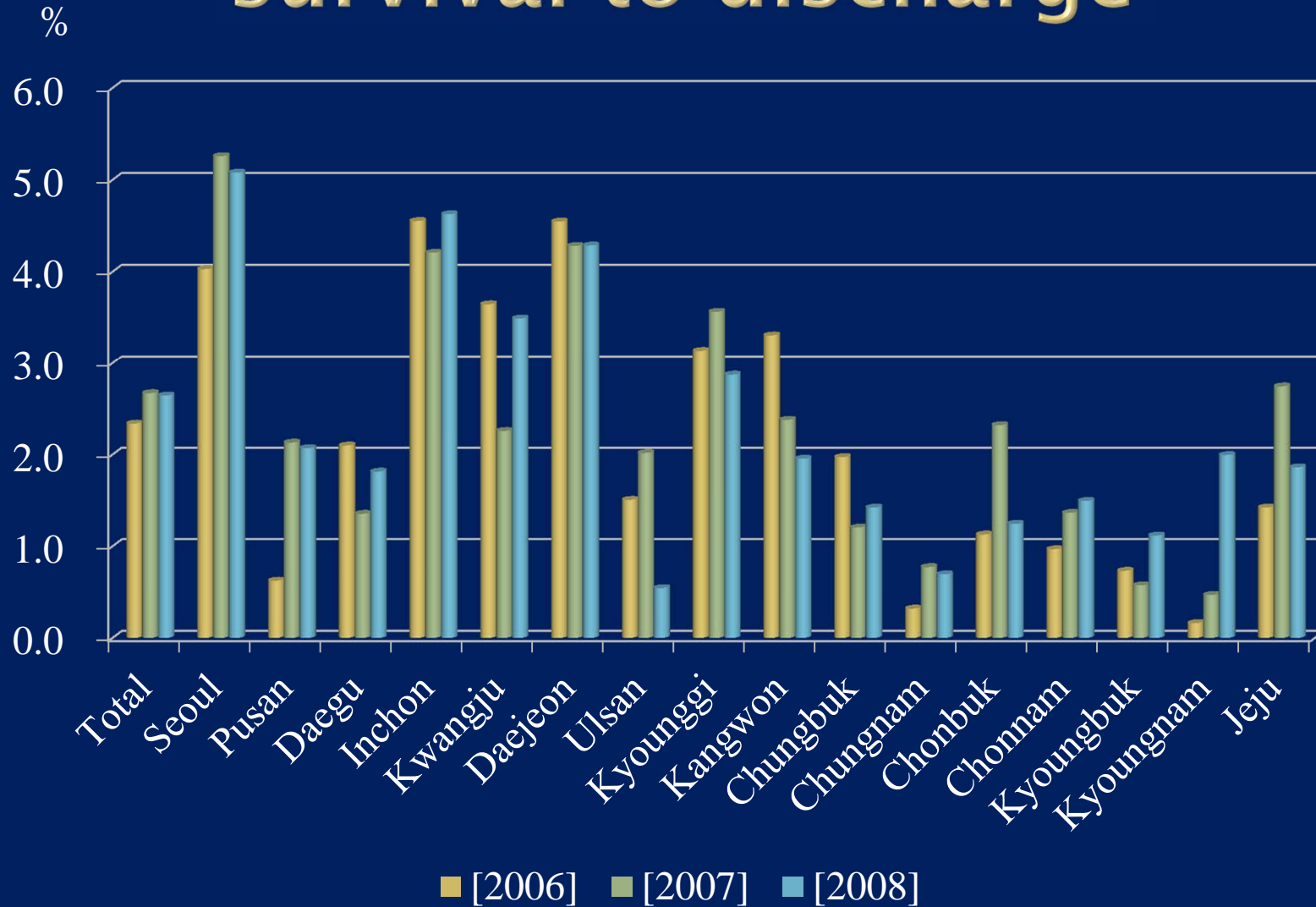
Age distribution



Main outcomes

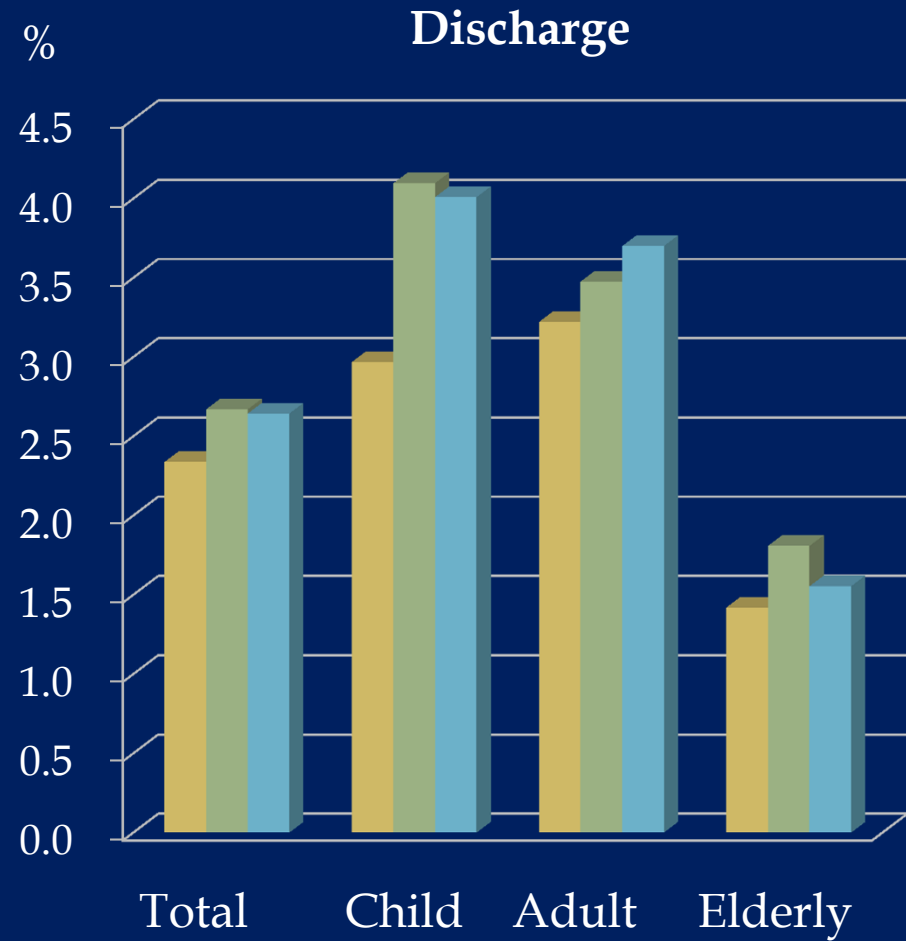
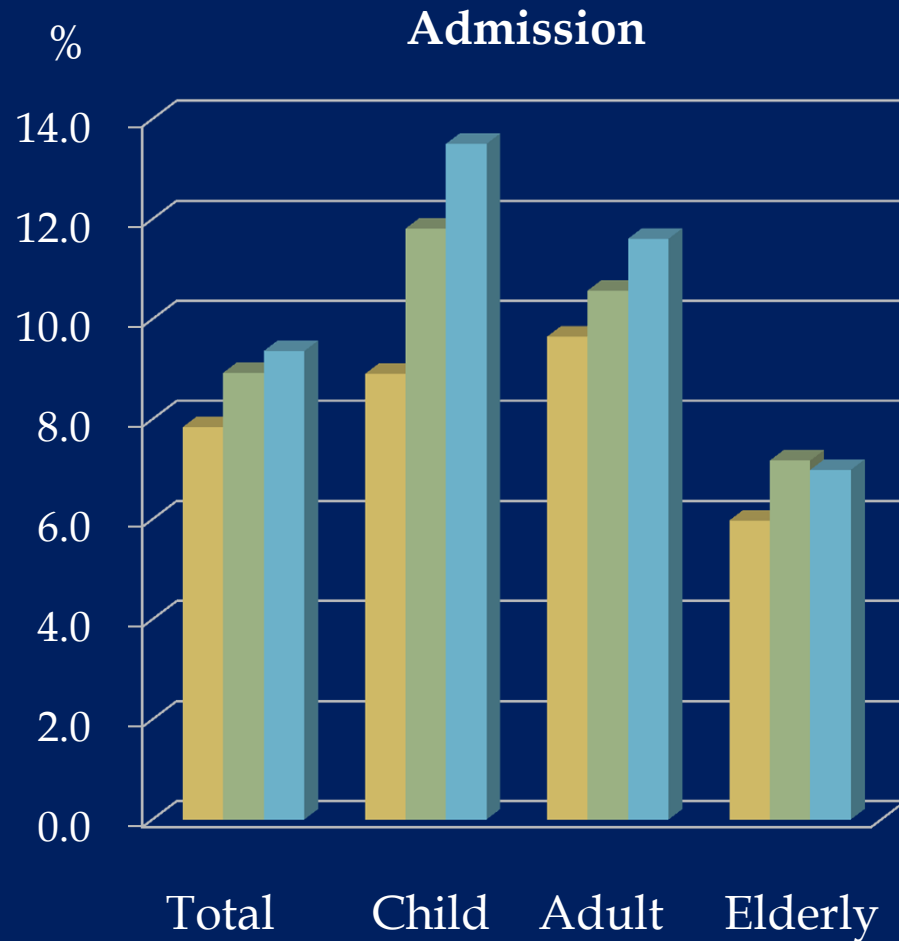
Outcomes		2006		2007		2008	
		N	%	N	%	N	%
Total		16,345	100	18,063	100	197,07	100
Death		15,369	94.0	16,918	93.7	18,458	91.7
Admission		1,797	11.0	2,201	12.2	2,414	12.2
Discharge		371	2.3	470	2.6	501	2.5
Good	CPC1	63	0.4	87	0.5	93	0.5
	CPC2	34	0.2	42	0.2	59	0.3
Bad	CPC3	43	0.3	70	0.4	39	0.2
	CPC4	140	0.9	159	0.9	277	1.4
	CPC5	45	0.3	76	0.4	18	0.1

Regional variations of survival to discharge



ASSOCIATION BETWEEN RISK FACTORS AND OUTCOMES

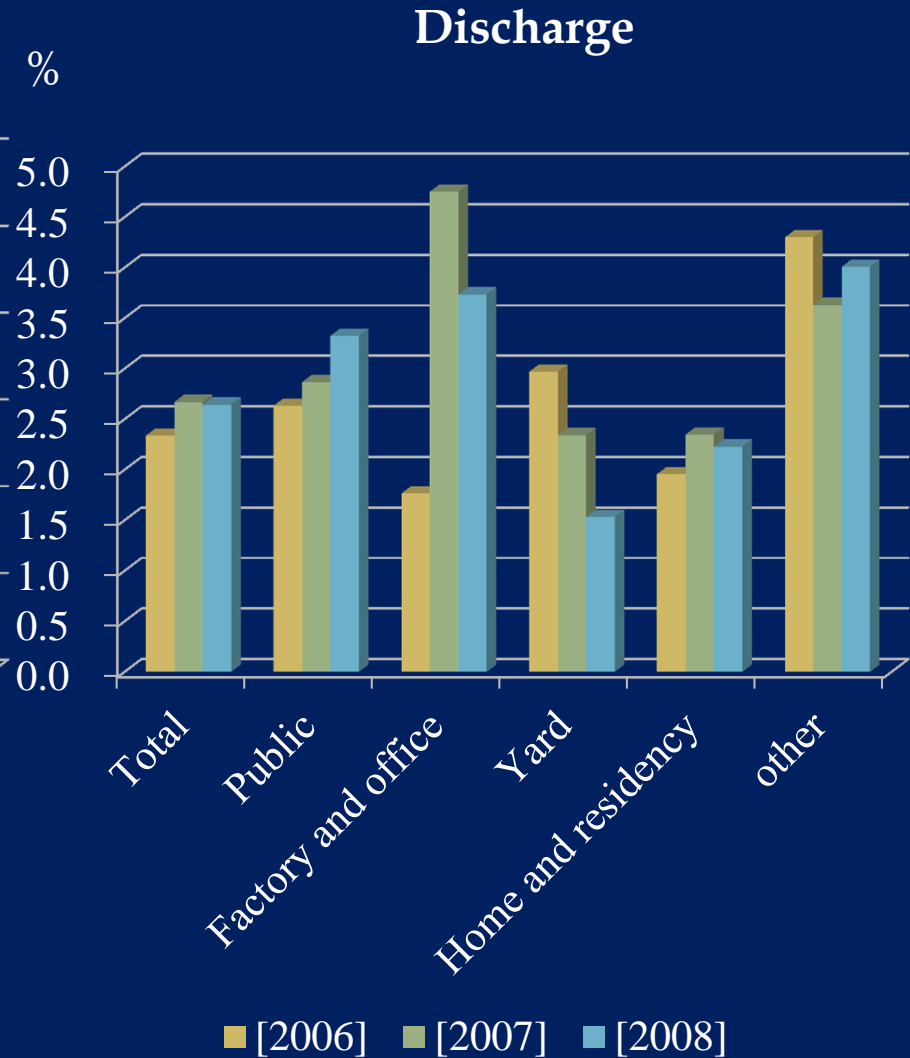
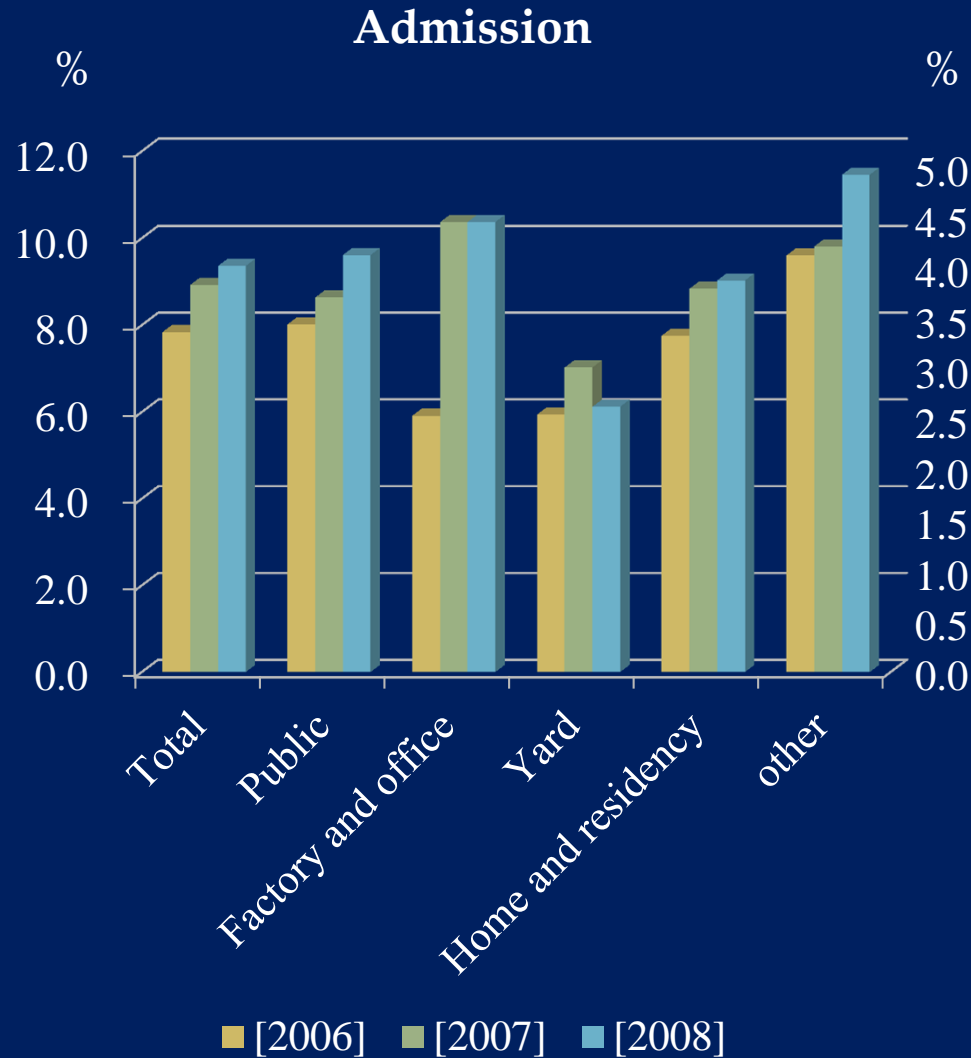
Age and outcomes



■ 2006 ■ 2007 ■ 2008

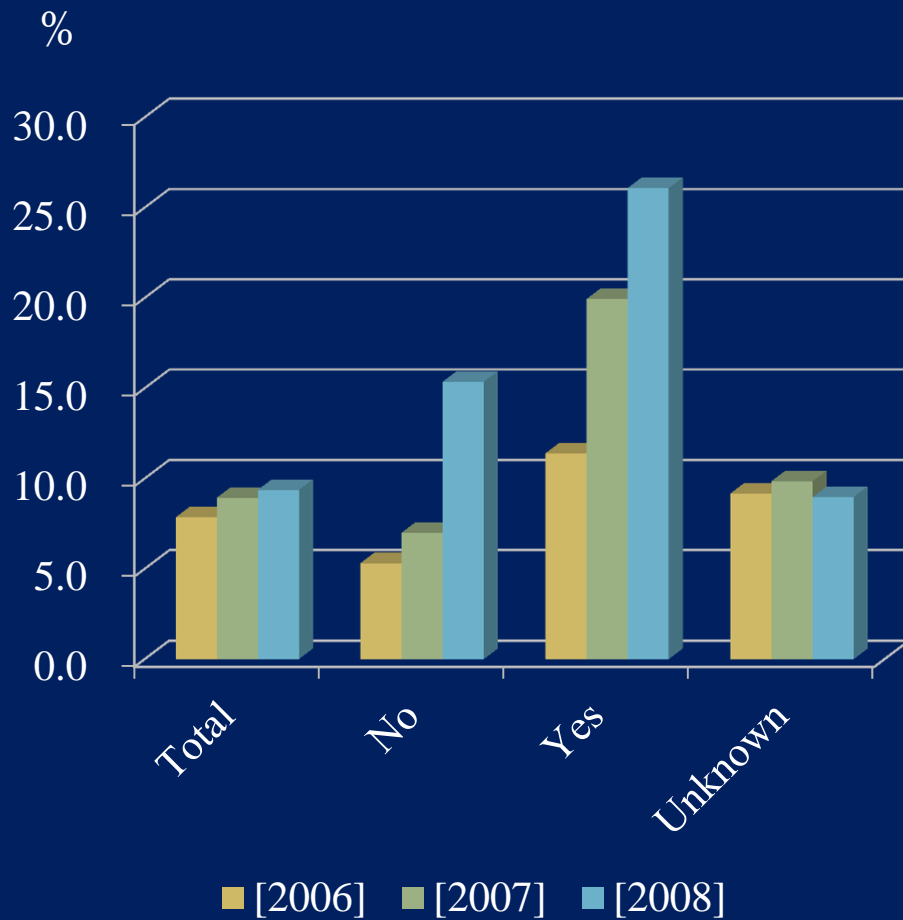
■ 2006 ■ 2007 ■ 2008

Places and Outcomes

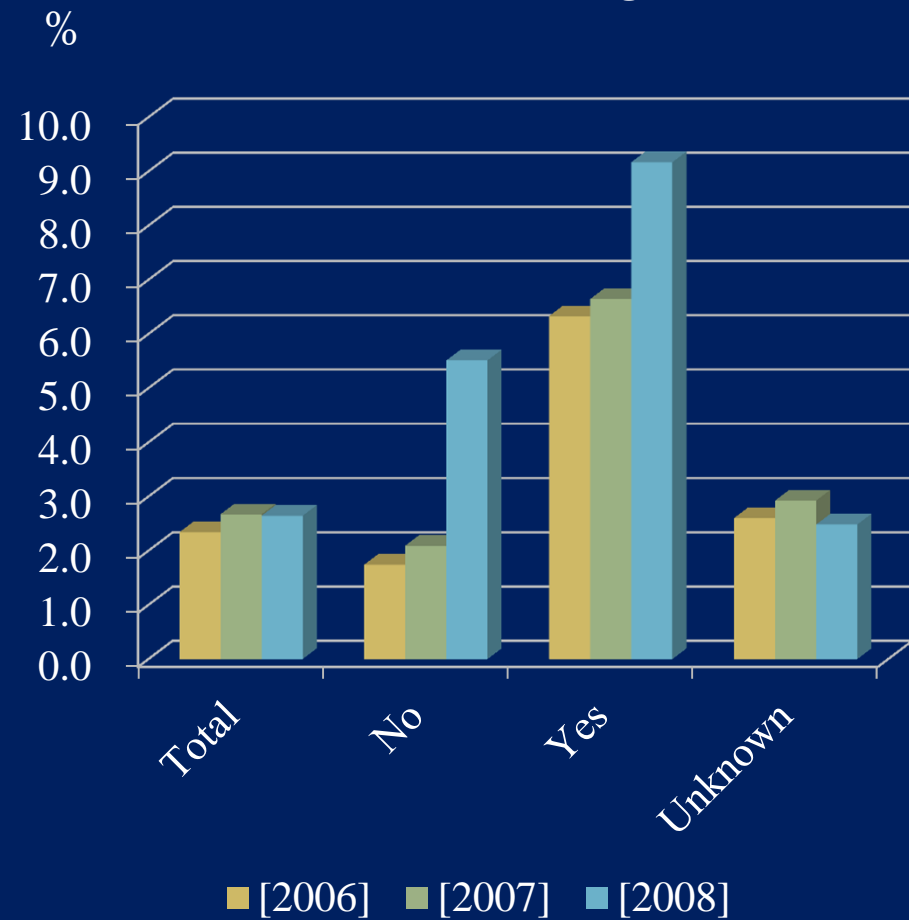


Bystander CPR and Outcomes

Admission

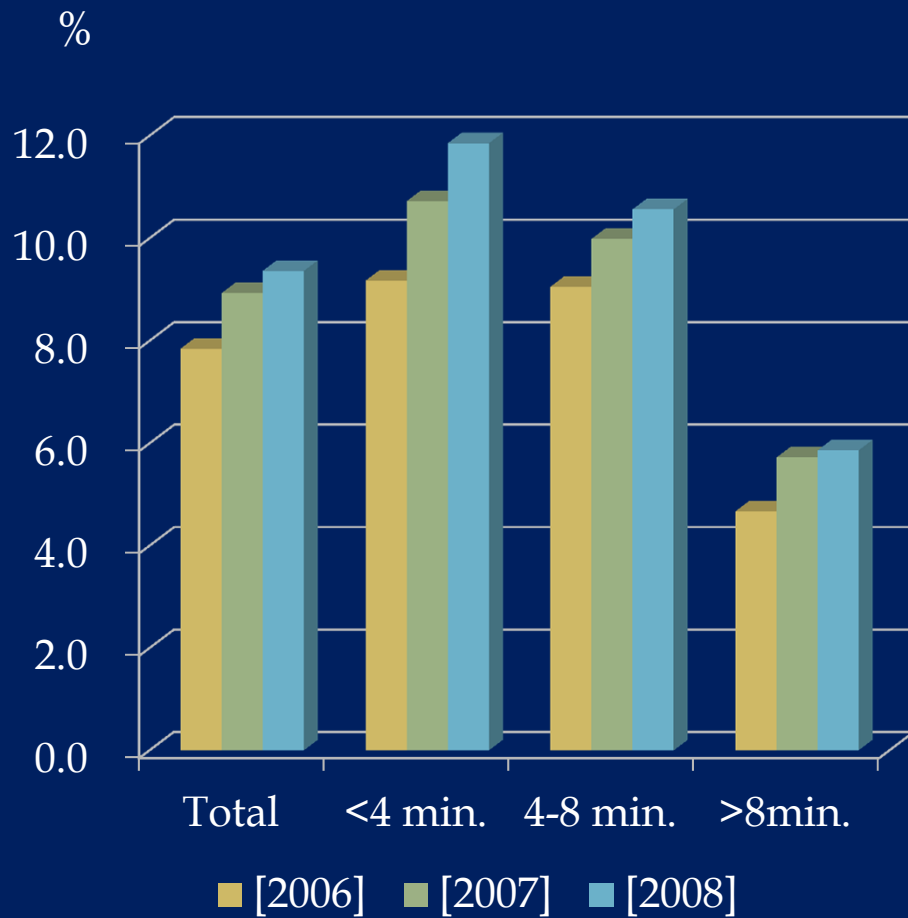


Discharge

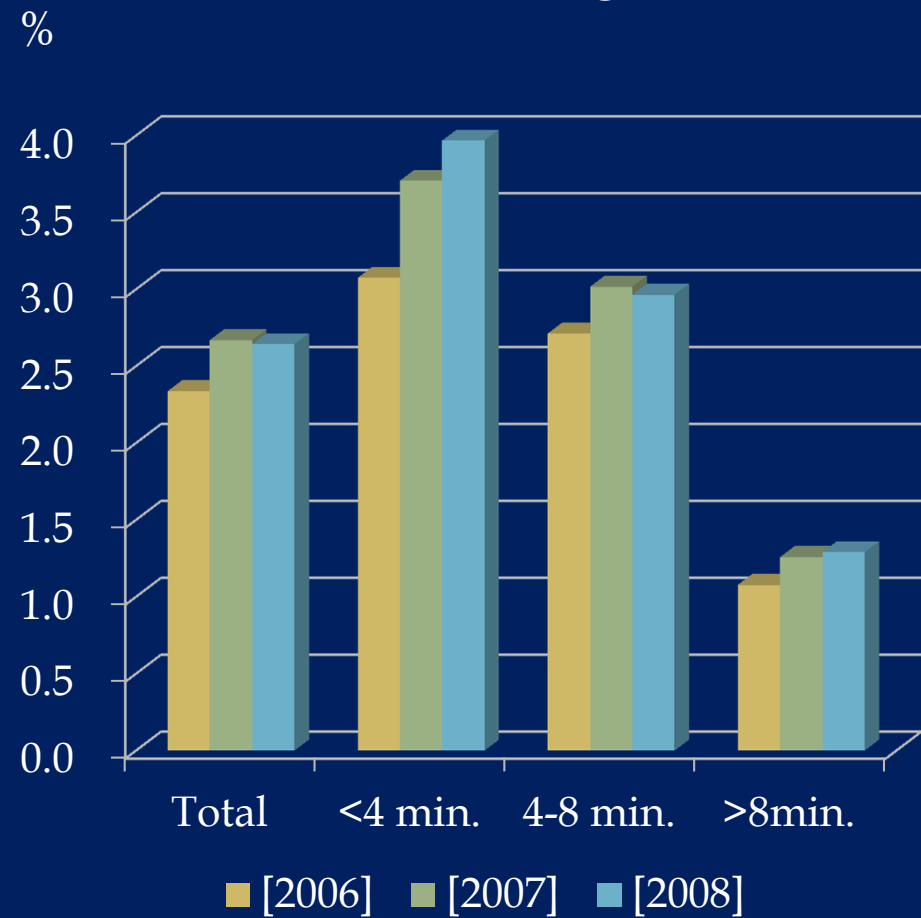


Response time and Outcomes

Admission

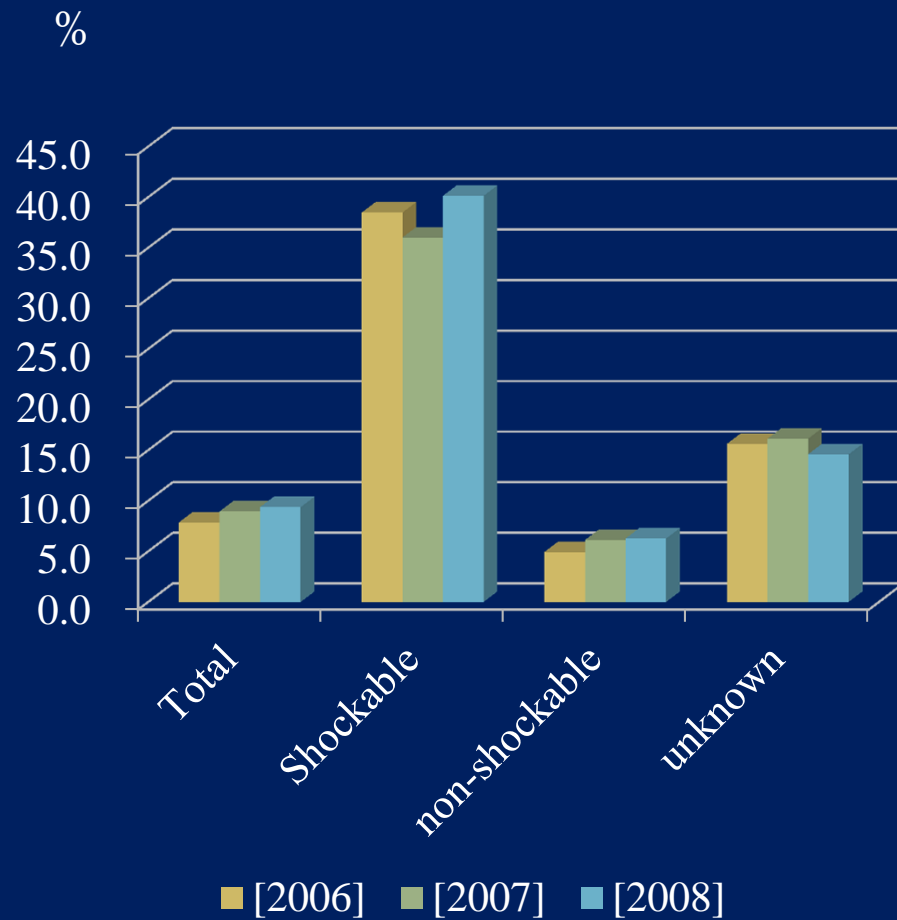


Discharge

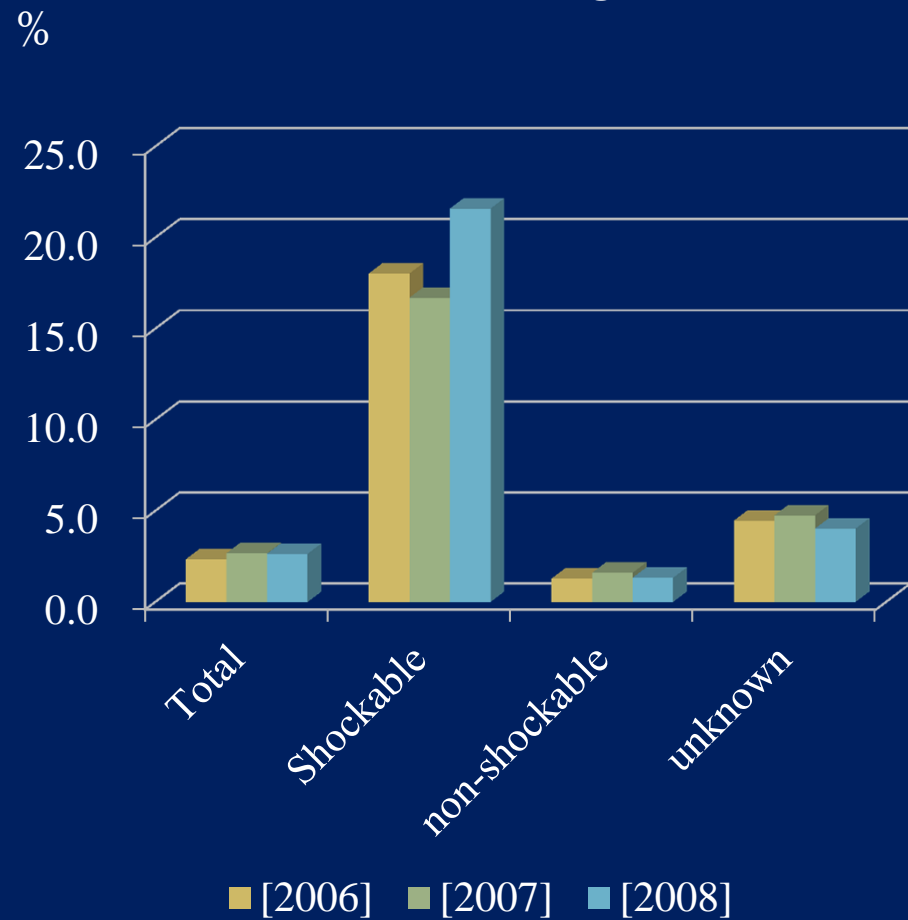


First ECG and Outcomes

Admission



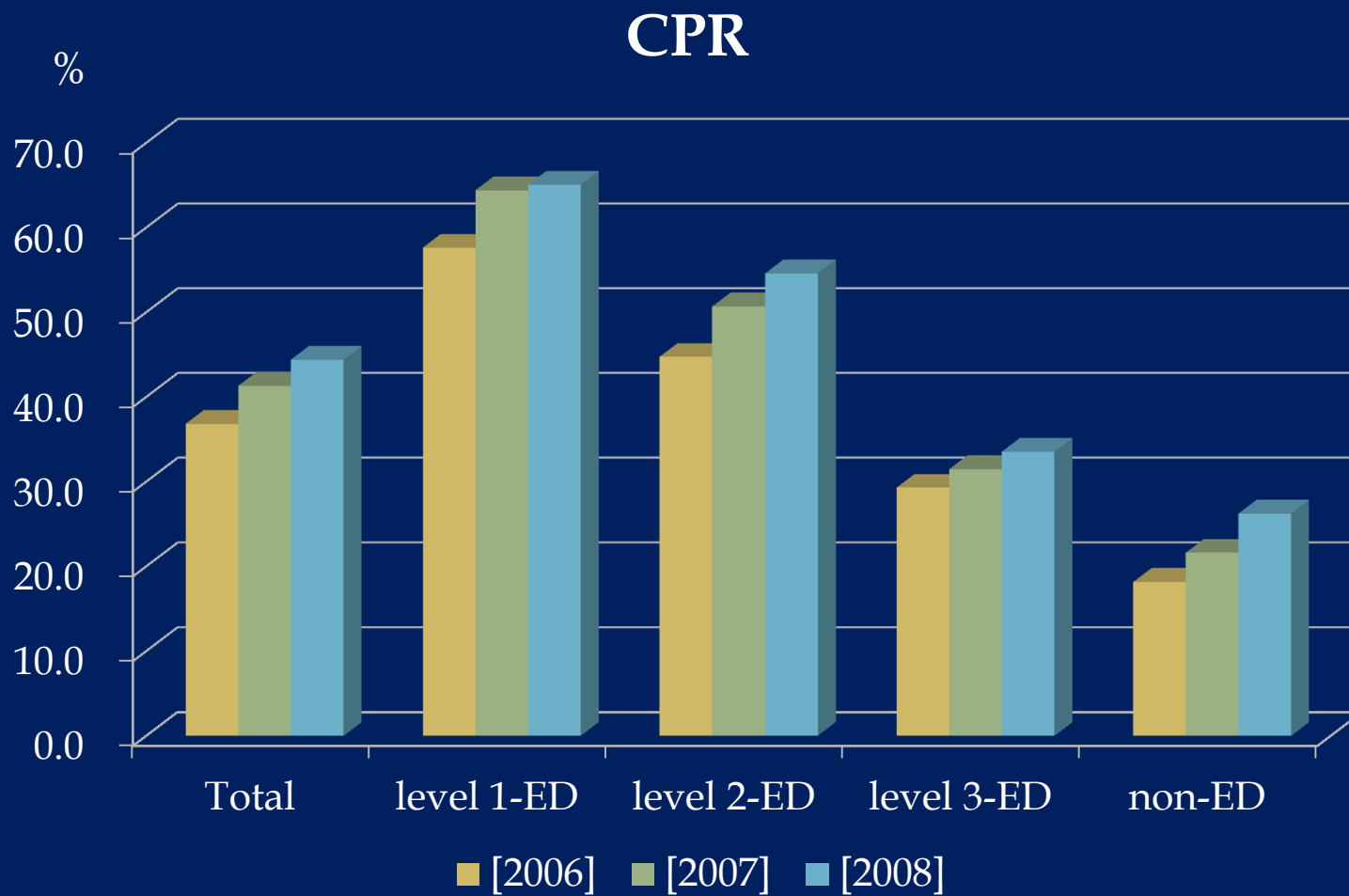
Discharge



HOSPITAL PERFORMANCE

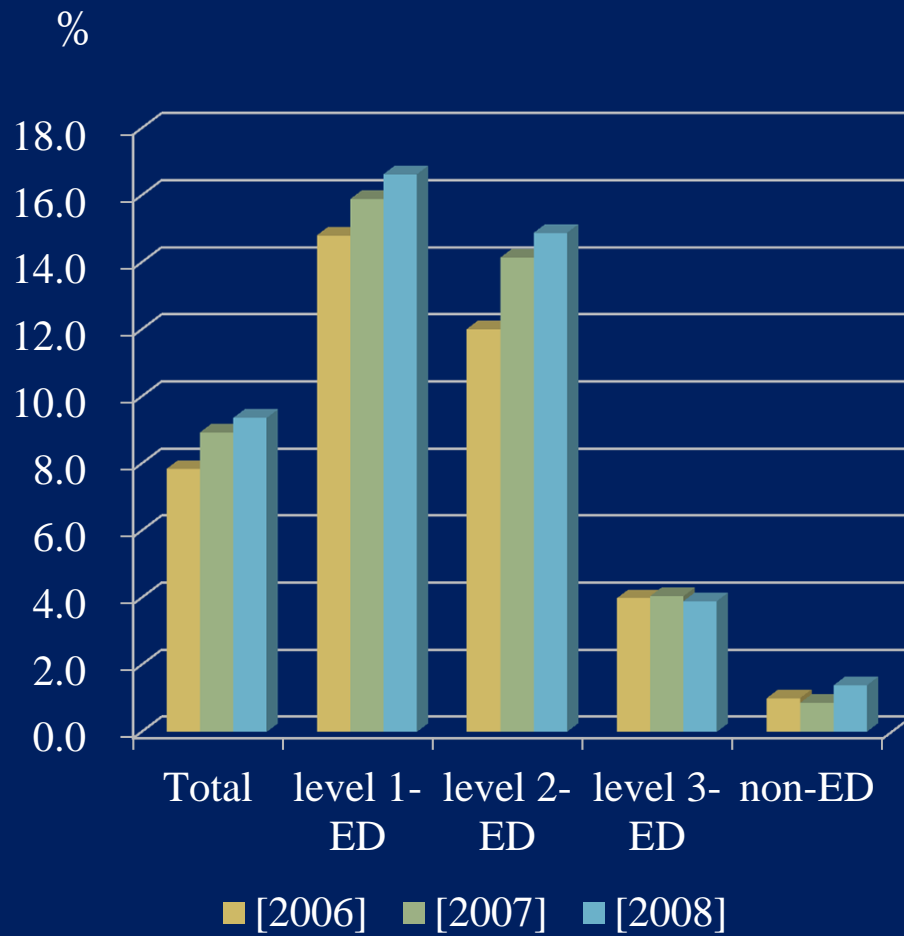
Regionalization strategy

ED levels and CPR

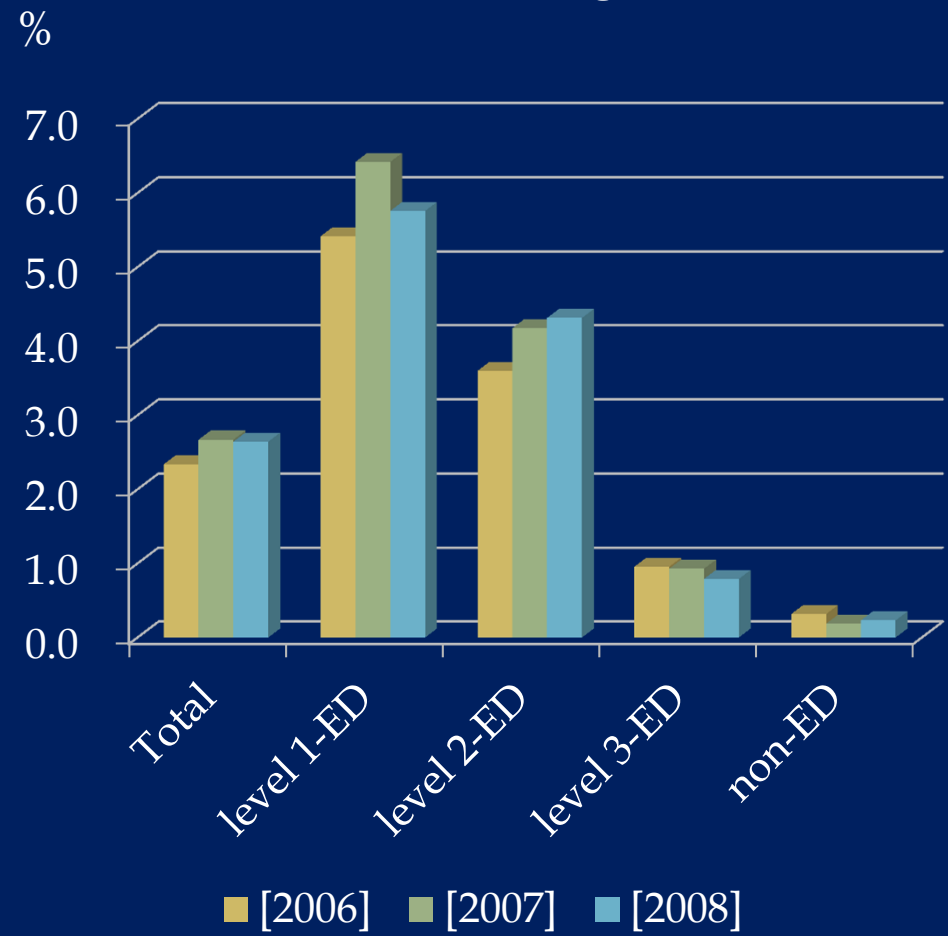


ED levels and Outcomes

Admission

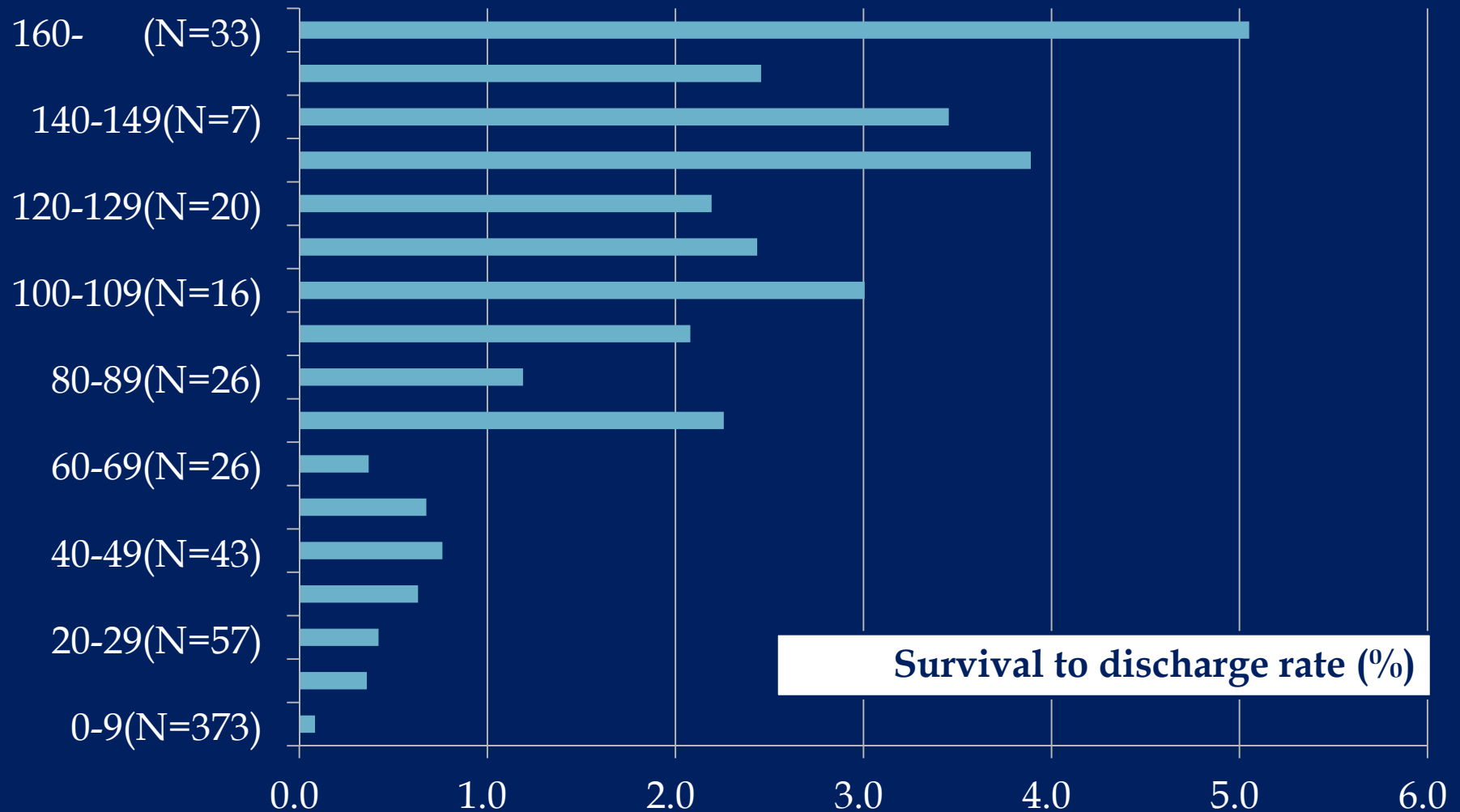


Discharge



CPR case volume and outcomes

CPR volume (Number of hospital)



CPR case volume and Outcomes

Multivariate logistic regression model

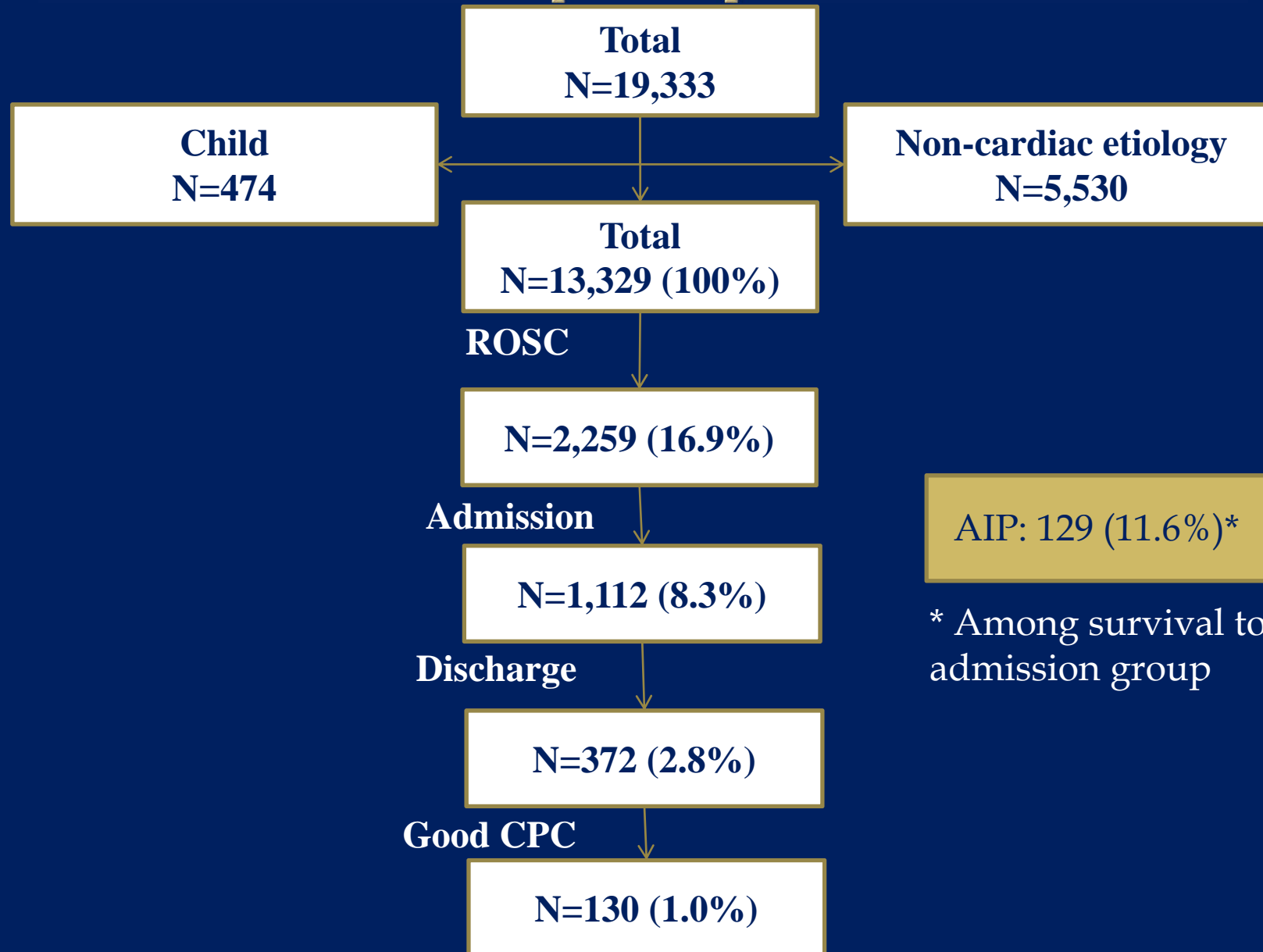
Hospital outcome	Total	Survival		Unadjusted			Adjusted*		
		N	%	OR	95% CI		OR	95% CI	
Total									
Survival to admission									
Low volume (<33)	5619	603	10.7	1			1		
High volume (>=33)	5619	785	14.0	1.35	1.20	1.51	1.47	1.29	1.67
Survival to discharge									
Low volume (<33)	5619	151	2.7	1			1		
High volume (>=33)	5619	262	4.7	1.77	1.45	2.17	1.91	1.54	2.37

*Adjustment for gender, age call to field time, call to emergency department (ED) arrival time, witnessed, bystander cardiopulmonary resuscitation(CPR), place of defibrillation, cause of arrest, initial ECG, CPR in prehospital or ED.

High Volume vs. Low Volume

- ▣ Adjusted OR (95% CI)
 - Pediatric OHCA (<20 years old) (N= 1,995)
 - ▣ Survival to discharge: 2.68 (1.12-6.41)
 - ▣ Survival to discharge: 2.49 (1.46-4.23)
 - Traumatic OHCA
 - ▣ Survival to discharge: 2.12 (1.63-2,76)
 - ▣ Survival to discharge: 1.88 (1.64-2.16)

Active Interventions for OHCA survivors [2008]



Active Intervention vs. Conservative Management [2008]

	Active Intervention Protocol		Conservative Management Protocol	
	N	%	N	%
Total	129	11.6	983	88.4
Reperfusion	60	5.4	1052	94.6
CABG	5	0.4	1107	99.6
ICD	14	1.3	1098	98.7
Hypothermia	64	5.8	1048	94.2

Active intervention vs. outcome Propensity score matched samples

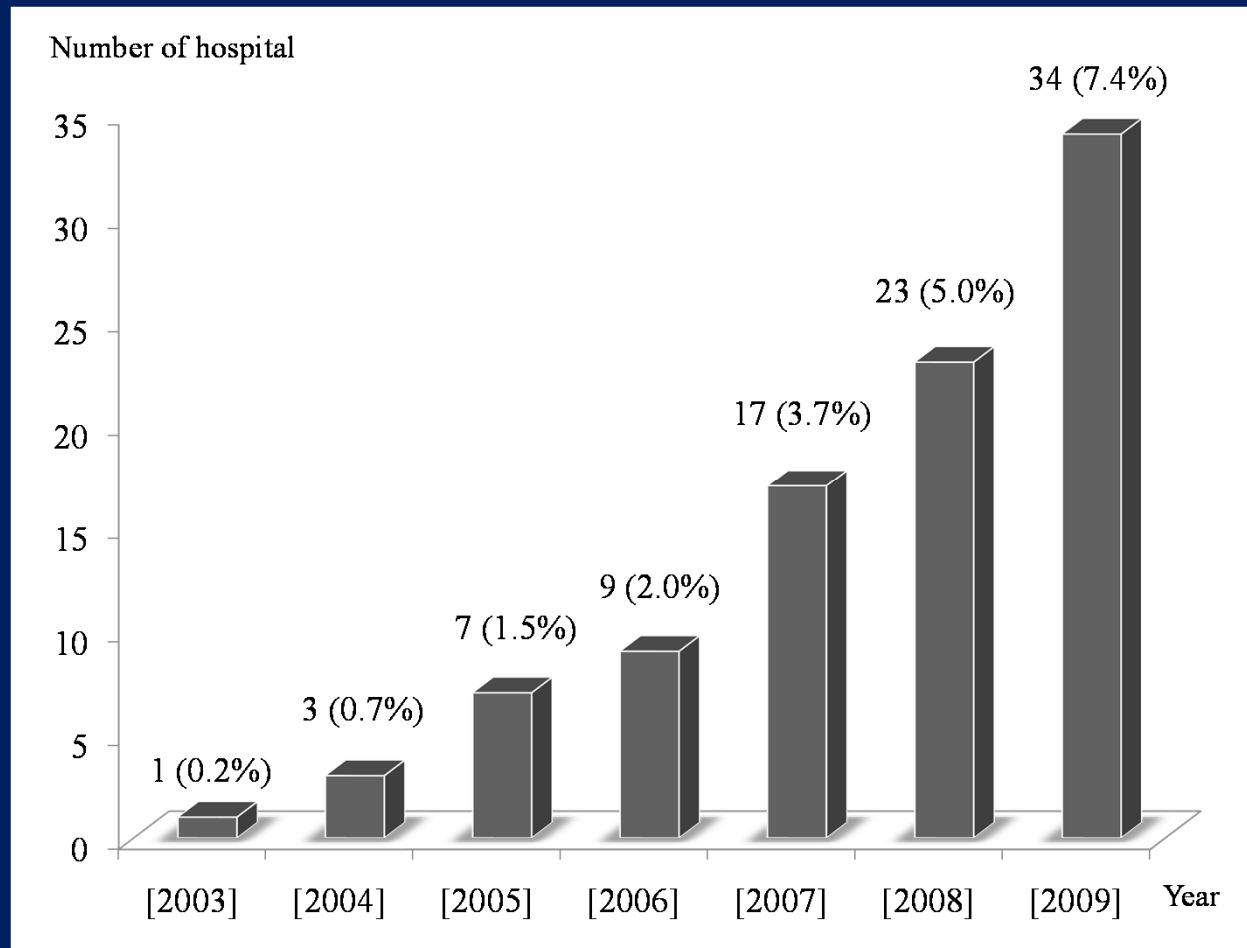
Hospital outcome	Total	Survival		Adjusted		
		N	%	OR	95% CI	
Total						
Survival to discharge						
CMP	124	49	39.5	1		
AIP	124	70	56.5	2.16	1.23	3.80
Good CPC						
CMP	124	26	21.0	1		
AIP	124	37	30.1	1.92	0.97	3.81

*Adjustment for gender, age call to field time, call to emergency department (ED) arrival time, witnessed, bystander cardiopulmonary resuscitation(CPR), place of defibrillation, cause of arrest, initial ECG, ED level.

CMP: conservative management protocol

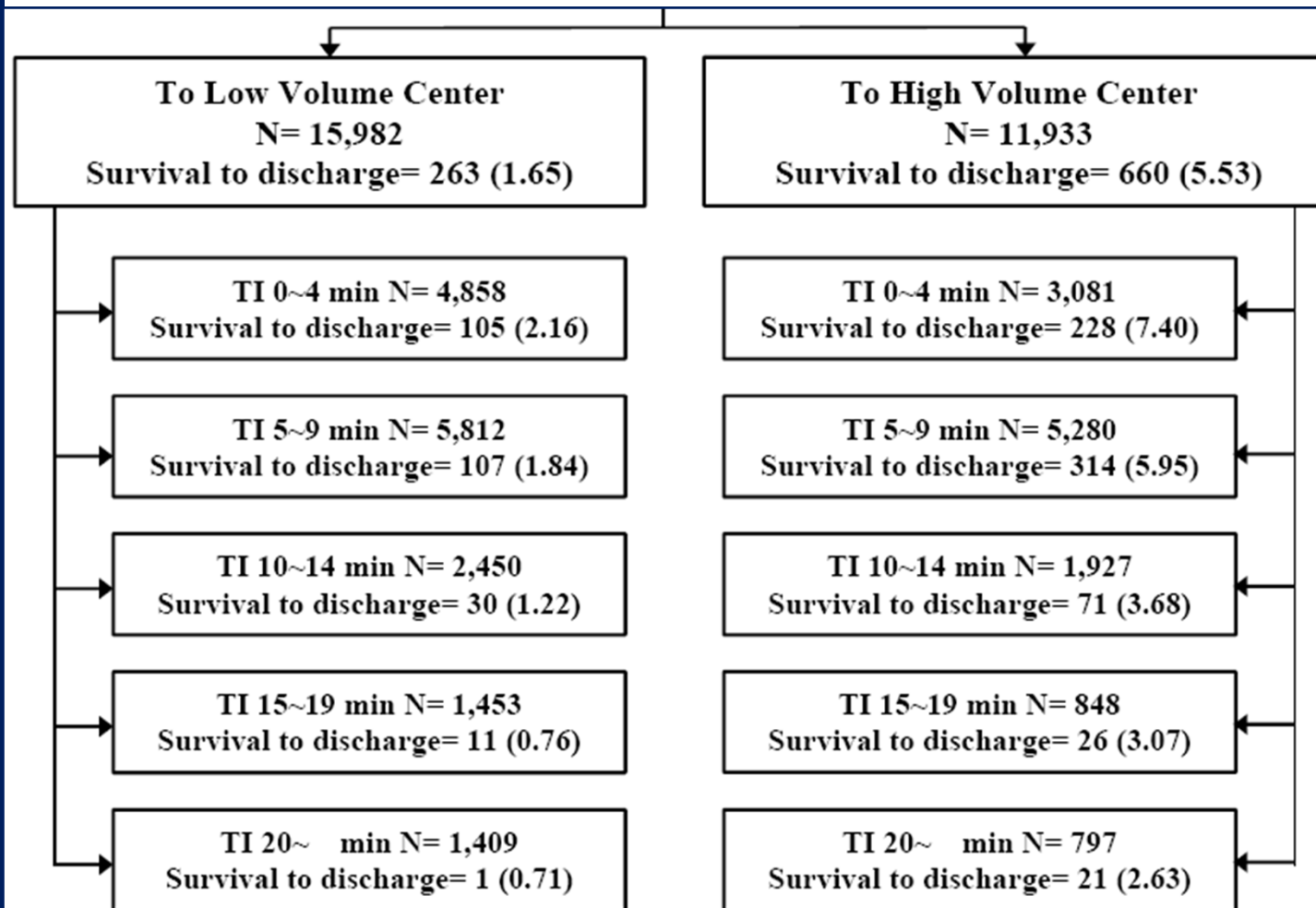
AIP: active intervention protocol

Hypothermia Protocol Accepted by Year in Korea

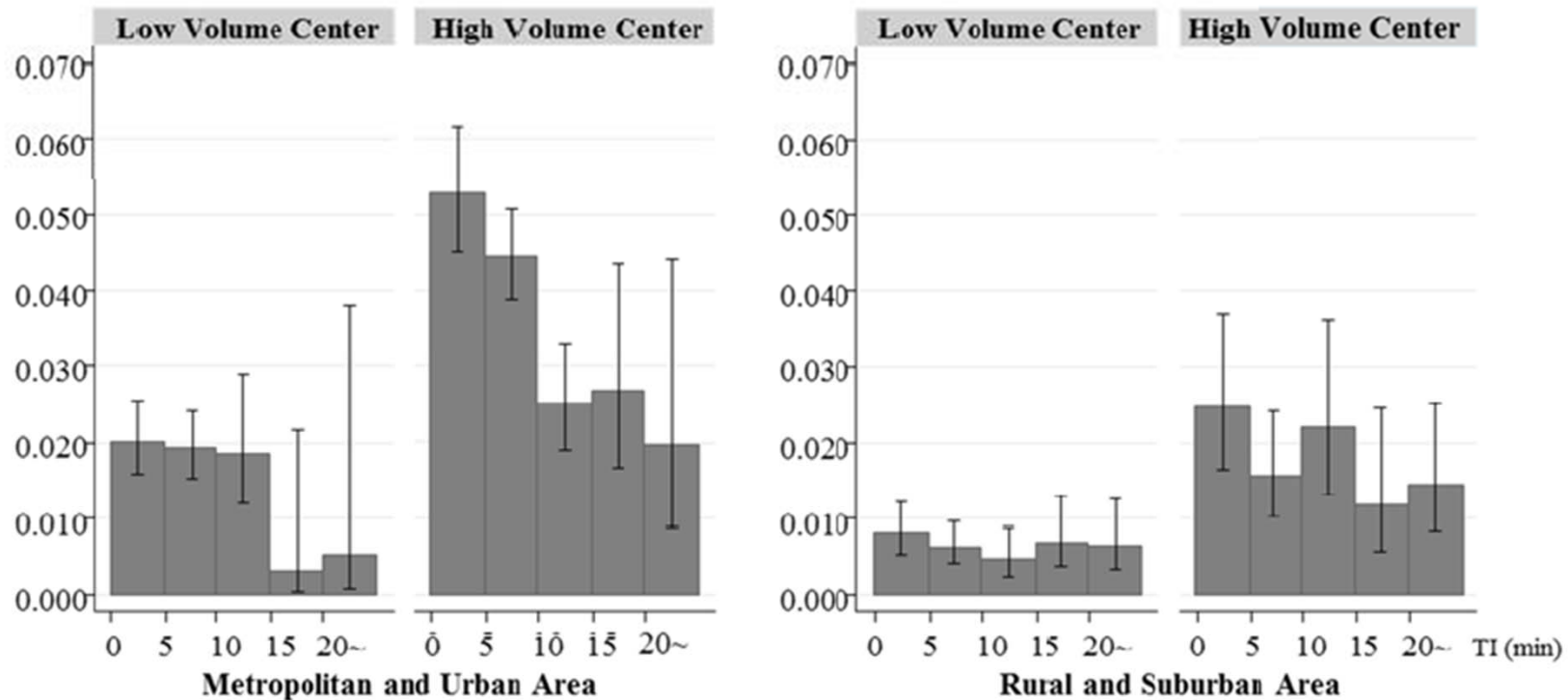


Telephone survey: N=840
Successful information: N=461

Resuscitation attempted and cardiac etiology N=27,915 [2006-2008]



Provability of Survival by Transport to HV vs. LV



Cut-off number for volume = 33 per year

Regionalization Strategy Issues

- ▣ Cardiac Arrest Center (CAC)-evidences
 - High volume
 - Active intervention protocol for survivors
 - Safety and efficiency of longer transport

- ▣ Post-resuscitation protocol- future study
 - EMS transport protocol
 - Inter-hospital transport protocol
 - Optimal intensive care protocol

Limitations

- ▣ Retrospective observational study
 - Lack of information
 - Unknown outcomes
- ▣ Non-EMS-transported OHCA

Summary

- ▣ EMS-assessed OHCA cohort [2006-2008]
- ▣ From this cohort
 - Incidence and main outcomes
 - Association between risk factors and outcomes
- ▣ Regionalization protocol
 - Evidence: case volume
 - Active intervention
 - Transport time for bypassing low volume hospital

THANK YOU