Hôpital Universitaire des Enfants
Paediatric Intensive Care
and Emergency Department

ULB

European Resuscitation Council

To preserve human life by making high quality resuscitation available to all

ERC Guidelines for Paediatric Resuscitation 2010

Cardiorespiratory arrest in children : specificities

Dominique Biarent

CONFLICT OF INTEREST

- No conflict of interest related to this presentation

ERC Guidelines 2010

Resuscitation 81 (2010) 1364–1388

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

European Resuscitation Council Guidelines for Resuscitation 2010 Section 6. Paediatric life support

Dominique Biarent[a,*], Robert Bingham[b], Christoph Eich[c], Jesús López-Herce[d], Ian Maconochie[e], Antonio Rodríguez-Núñez[f], Thomas Rajka[g], David Zideman[h]

[a] *Paediatric Intensive Care, Hôpital Universitaire des Enfants, 15 av JJ Crocq, Brussels, Belgium*
[b] *Great Ormond Street Hospital for Children, London, UK*
[c] *Zentrum Anaesthesiologie, Rettungs- und Intensivmedizin, Universitätsmedizin Göttingen, Robert-Koch-Str. 40, D-37075 Göttingen, Germany*
[d] *Pediatric Intensive Care Department, Hospital General Universitario Gregorio Marañón, Complutense University of Madrid, Madrid, Spain*
[e] *St Mary's Hospital, Imperial College Healthcare NHS Trust, London, UK*
[f] *University of Santiago de Compostela FEAS, Pediatric Emergency and Critical Care Division, Pediatric Area Hospital Clinico Universitario de Santiago de Compostela, 15706 Santiago de Compostela, Spain*
[g] *Oslo University Hospital, Kirkeveien, Oslo, Norway*
[h] *Imperial College Healthcare NHS Trust, London, UK*

”To preserve human life by making high quality resuscitation available to all”

NEW GUIDELINES 2010

Aimed at changing the rules only if

- Based on scientific evidences
- To simplify
- To assist teaching and retention
- To ensure consistency with adult GL

ERC Guidelines 2010

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Pulse palpation

- Presence or absence of pulse not reliably determined in <10 s by HCP (Tibballs, 2010)
- Cardiac arrest & need for CPR must be determined by:
  - **Unresponsiveness**
  - **Absence of normal breath**
  - **Absence of signs of life**

(pulse palpation can be added by HCP)

PAEDIATRIC GUIDELINES 2010

CC only or Standard CPR?

- **Observational study**
  - 2005 – 2007
  - **5,170 Children (< 17 Y)**
  - 5,158 enrolled
- **End point: CPC 1 & 2 after 30 d**
- **CA of cardiac origin**
  - No CPR: 709
  - S-CPR: 496 CC-CPR: 289
- **CA of non cardiac origin**
  - No CPR: 2,010
  - S-CPR: 1,055 CC-CPR: 599

PAEDIATRIC GUIDELINES 2010

	No CPR (n=2719)	Bystander CPR (n=2439)	Bystander CPR vs no CPR*	Compression-only CPR (n=888)	Conventional CPR (n=1551)	Conventional CPR vs compression-only CPR*
Non-cardiac origin						
Total	2010	1654		599	1055	
Age 1–17 years	1293	1004		380	624	
ROSC before hospital arrival	60 (4·6%)	82 (8·2%)	1·97 (1·35–2·87)	20 (5·3%)	62 (9·9%)	2·17 (1·24–3·82)
1-month survival	89 (6·9%)	133 (13·2%)	2·09 (1·55–2·83)	34 (8·9%)	99 (15·9%)	1·89 (1·23–2·91)
Neurologically favourable 1-month survival	20 (1·5%)	51 (5·1%)	4·17 (2·37–7·32)	6 (1·6%)	45 (7·2%)	5·54 (2·52–16·99)
Age 0–<1 years	717	650		219	431	
ROSC before hospital arrival	30 (4·2%)	23 (3·5%)	0·92 (0·32–2·71)	9 (4·1%)	14 (3·2%)	NA
1-month survival	56 (7·8%)	51 (7·8%)	1·08 (0·71–1·65)	17 (7·8%)	34 (7·9%)	NA
Neurologically intact 1-month survival	14 (2·0%)	13 (2·0%)	1·19 (0·54–2·61)	2 (0·9%)	11 (2·6%)	NA
Cardiac origin						
1-month survival	36 (10·6%)	71 (16·1%)	1·41 (0·86–2·30)	26 (16·5%)	45 (16·0%)	0·96 (0·52–1·75)
Neurologically favourable 1-month survival	14 (4·1%)	42 (9·5%)	2·21 (1·08–4·54)	14 (8·9%)	28 (9·9%)	1·20 (0·55–2·66)
Age 0–<1 years	370	345		131	214	
ROSC before hospital arrival	8 (2·2%)	8 (2·3%)	1·01 (0·36–2·86)	2 (1·5%)	6 (2·8%)	NA
1-month survival	17 (4·6%)	22 (6·4%)	1·28 (0·64–2·56)	7 (5·3%)	15 (7·0%)	NA
Neurologically intact 1-month survival	5 (1·4%)	4 (1·2%)	0·93 (0·20–4·32)	1 (0·8%)	3 (1·4%)	NA

Data are number of patients (%), unless otherwise indicated. Data for type of CPR by bystander were not available for 12 (<1%) children. CPR=cardiopulmonary resuscitation.

Children need breaths…

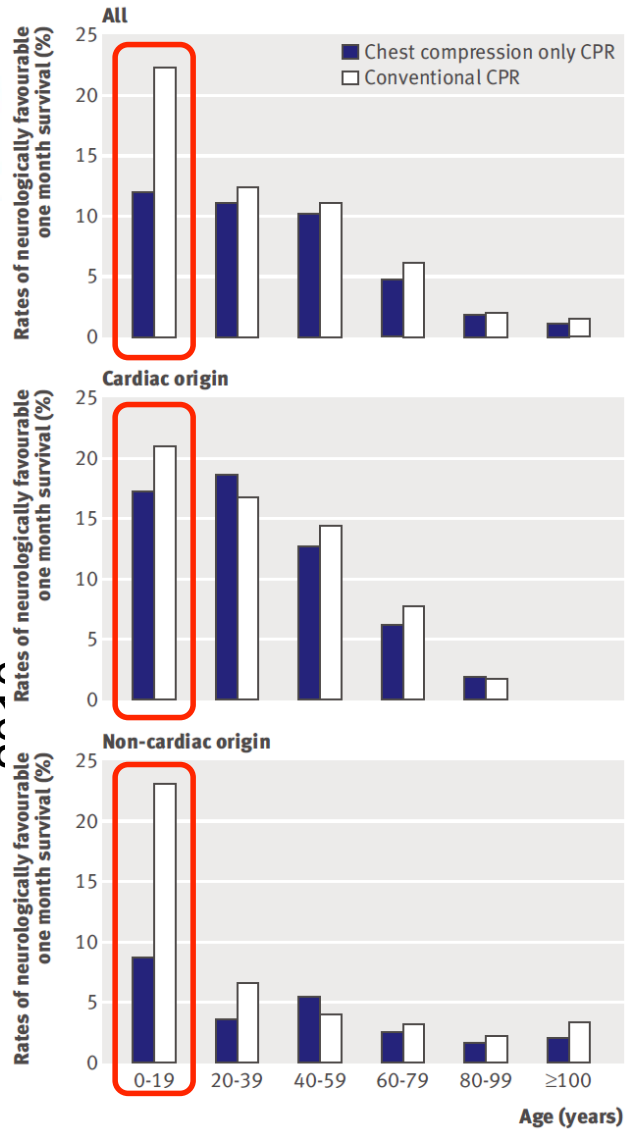
- **Observational study**
  - **40.034 enrolled**
- **End point: CPC* 1 & 2 after 30 d**
- **CC only (n=20,707)**
- **S-CPR (n=19,328)**

ERC

* Good neurological outcome or moderate disability

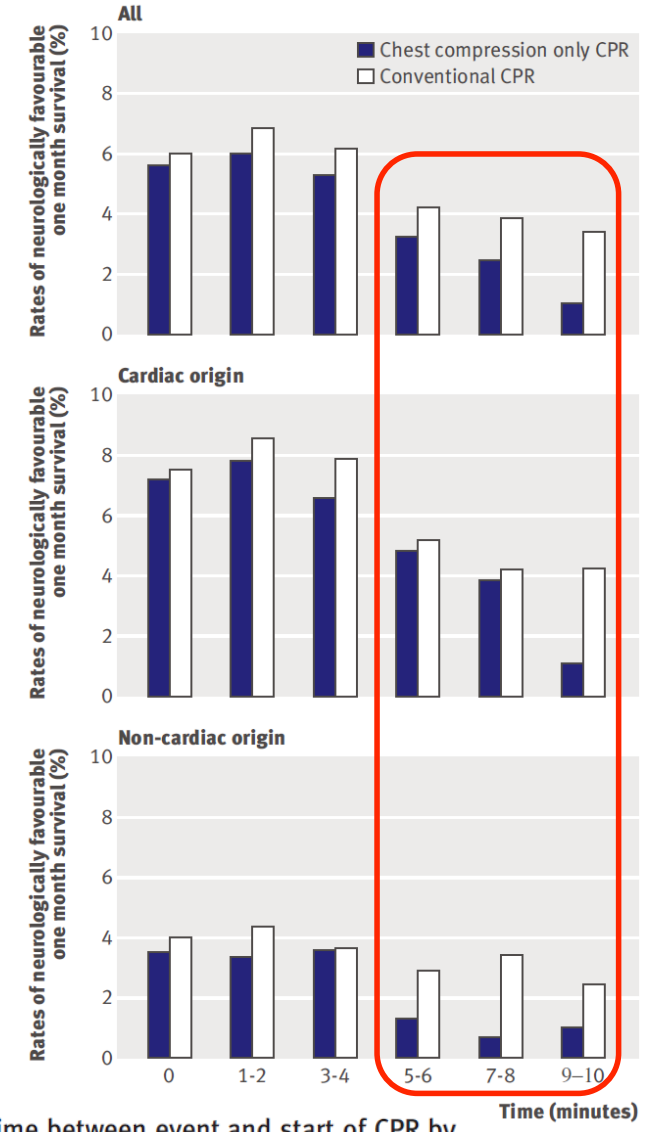
S-CPR : Favourable one month survival after CA in children, for non cardiac events and delayed CPR / all cases combined

ERC Guidelines



by bystander by age and origin of cardiac arrest

BMJ 2011;342:c7106



by bystander by time between event and start of CPR by bystander and origin of cardiac arrest

PAEDIATRIC GUIDELINES 2010

Chest compressions

ERC Guidelines 2010

- Lay rescuer (single) 30:2
- HCP with a duty to respond (normally at least 2 rescuers) 15:2
- Start with 5 breaths (for at least 2 efficient)
- Compression depth at least 1/3
- At least 100/min (100-120 min $^{-1}$)
- Lower half of the sternum
- Emphasize complete release

Lay rescuers

- Do what you have been taught for CPR
- If you were taught so
  - Do 5 breaths before starting chest compression
  - Adapt you CC to the child's size
  - Go for help after 5 cycles (1 min)

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Lay rescuers

Push hard and fast and completely release the pressure after each compression

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

AED

- Capable of identifying arrhythmias in children accurately
- Extremely unlikely to advise a shock inappropriately (Atkins, 2008)
- Check that performance has been tested against paediatric arrhythmias
- Only case reports for the use on infants (Bar-Cohen, Divekar)
- Incidence of shokable rhythm is low in infants (Atkins, Rodriguez, Samson)

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

AED

- Adolescent and children above 8
  - Use a standard AED
- Children 1-8
  - Use an AED with attenuator
    - Or a standard AED
- Infant
  - Use a manual defibrillator
    - Or an AED with attenuator
      - Or an AED

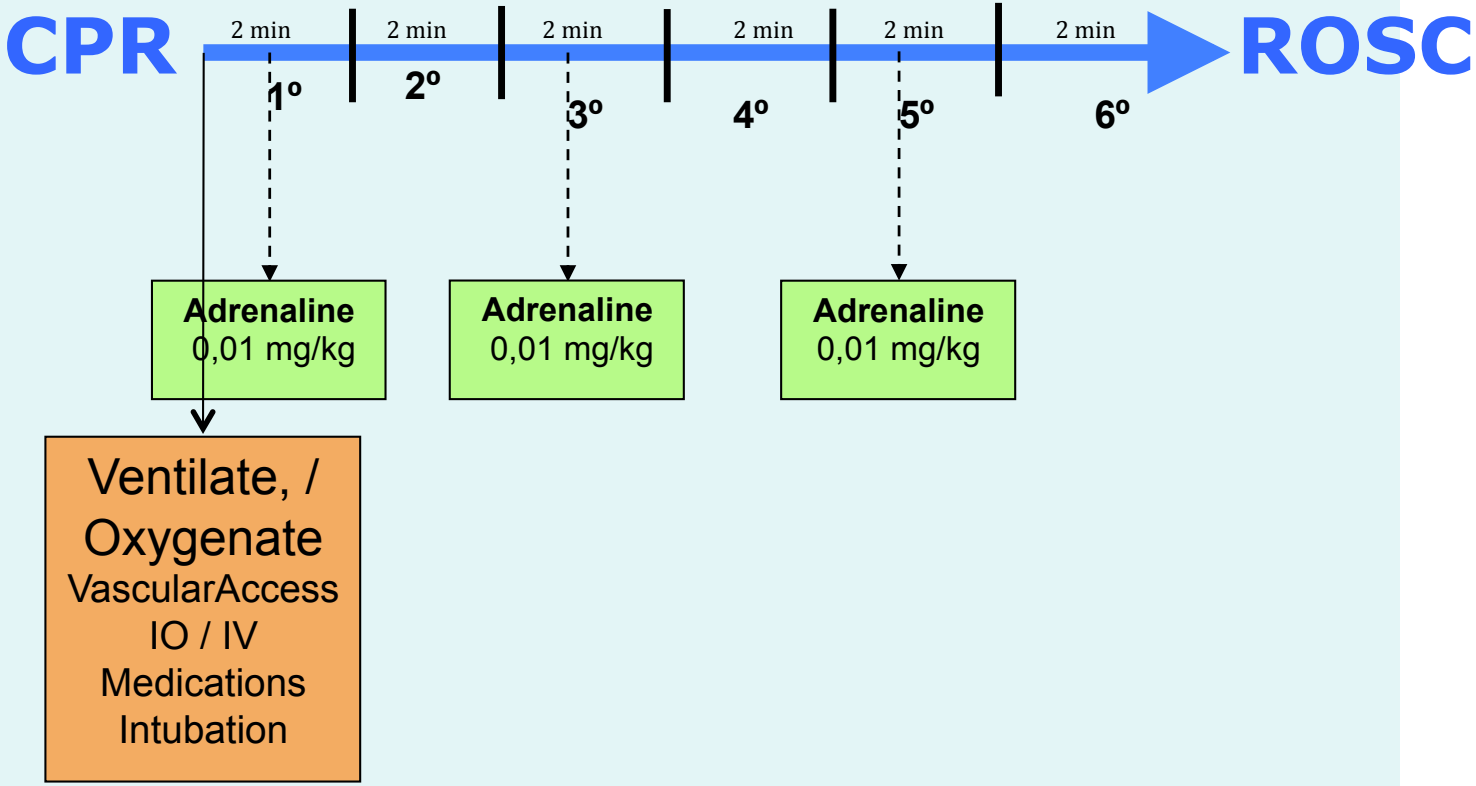
PAEDIATRIC GUIDELINES 2010

Defibrillation

ERC Guidelines 2010

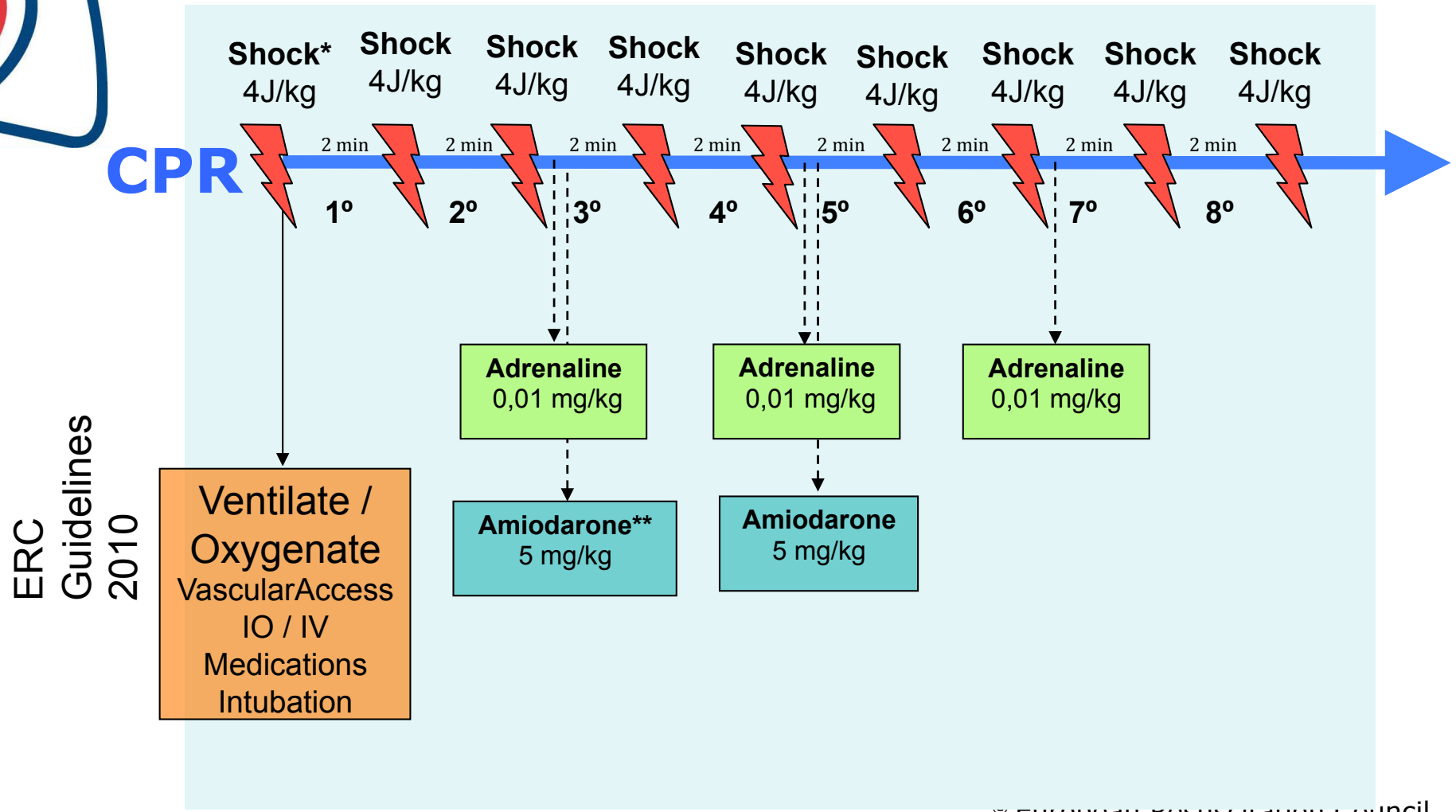
We recommend a single-shock strategy using a non-escalating dose of 4 J kg^{-1} (preferably biphasic but monophasic is acceptable)

CARDIAC ARREST : NON SHOCKABLE RHYTHM



ERC Guidelines 2010

CARDIAC ARREST : SHOCKABLE RHYTHM



PAEDIATRIC GUIDELINES 2010

Ventilation frequency

- Hyperventilation causes increased thoracic pressure, decreased cerebral and coronary perfusion, and poorer survival rates in animals and adults
- During CA : 10-12 min^{-1}
- After ROSC : 12-20 min^{-1} and normal CO2

ERC Guidelines 2010

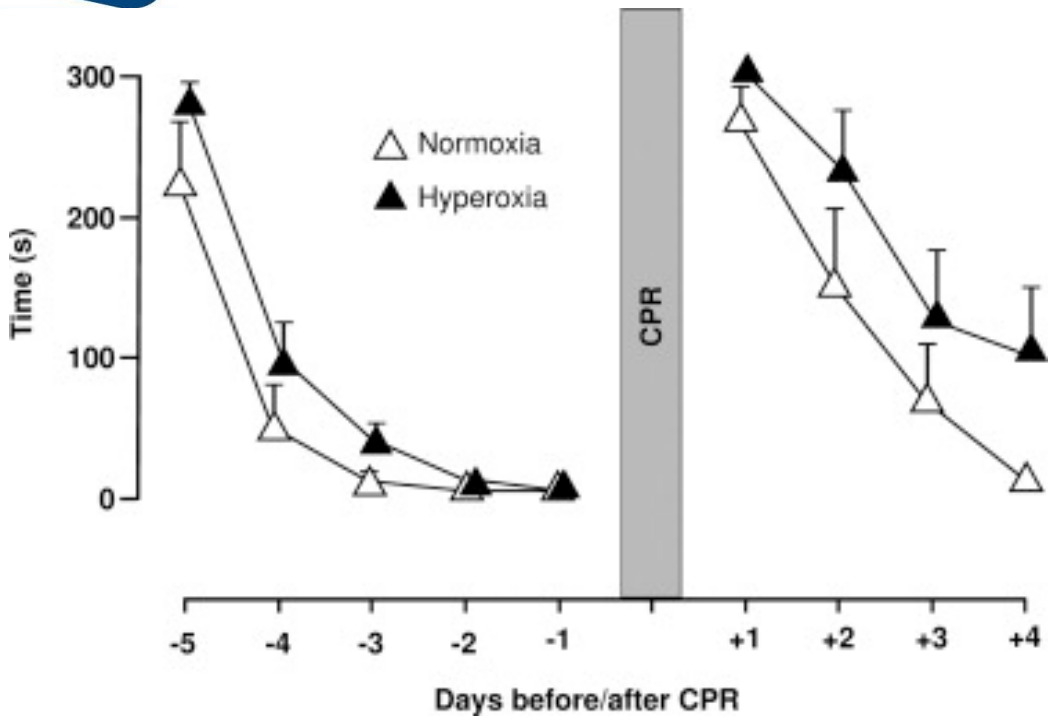
Capnography-Capnometry

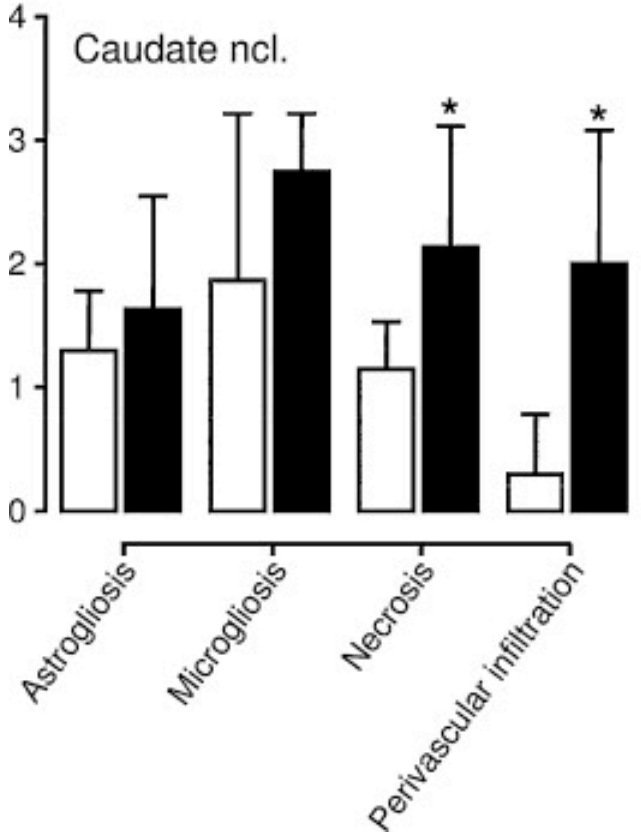
- Use ET CO_2 for CPR
  - efficiency of chest compressions and ROSC (Mauer, 1998, 67; Kolar, 2008, R115).
  - improve chest compression efficacy if the $ETCO_2$ <15mm (2 kPa)
- No threshold ET CO_2 value as indicator for discontinuation of resuscitation
- Use for confirm tube placement

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Oxygen damage



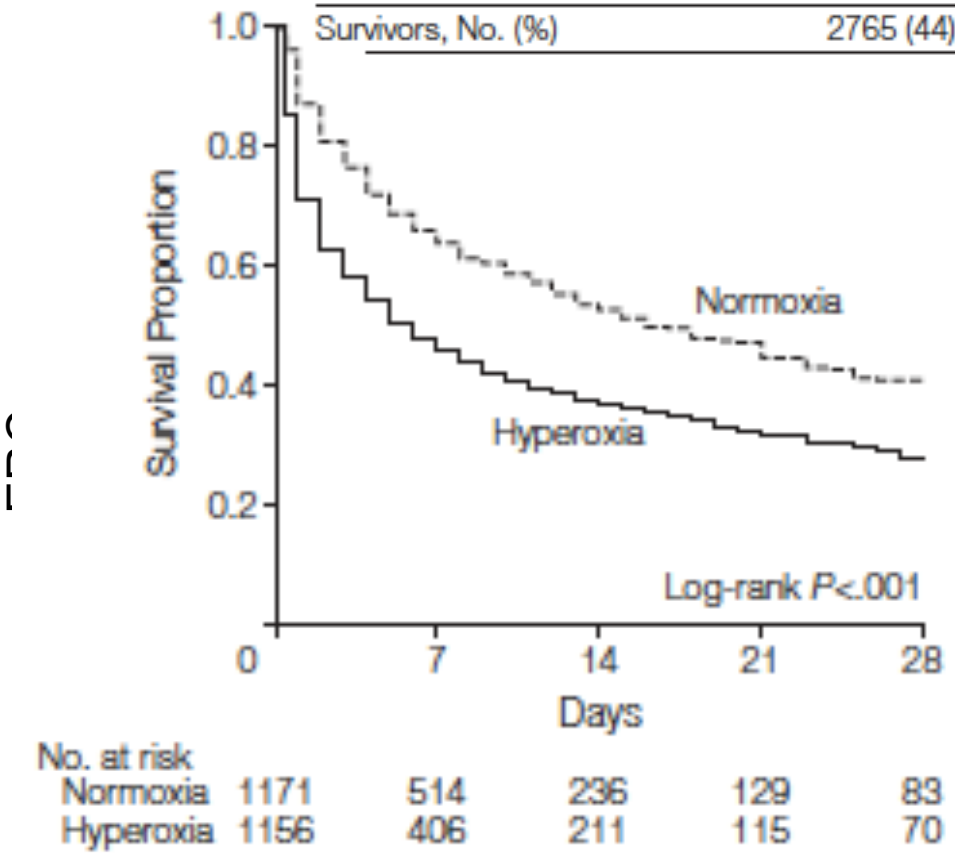


Reducing the duration of 100% oxygen ventilation in the early reperfusion period after cardiopulmonary resuscitation decreases striatal brain damage. Bruckner Resus 2010-1698

PAEDIATRIC GUIDELINES 2010

Hyperoxia

	All Patients (N = 6326)	Hypoxia (n = 3999)	Normoxia (n = 1171)	Hyperoxia (n = 1156)
In-hospital mortality, No. (%) [95% CI][a]	3561 (56) [55-58]	2297 (57) [56-59]	532 (45) [43-48]	732 (63) [60-66]
Survivors, No. (%)	2765 (44)	1702 (43)	639 (55)	424 (37)



After controlling counfounding factors Hyperoxia exposure had a OR for death of 1.8 (95%CI 1.5-2.2)

Kilgannon JAMA 2010-2165

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

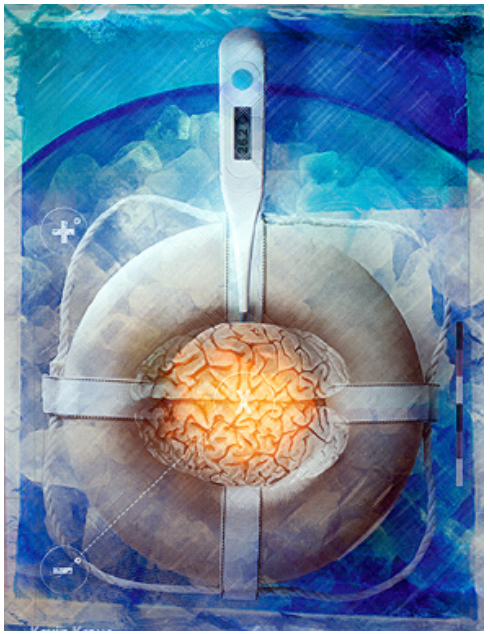
Titration of oxygen

- Potential harm from high O2 exposure after cardiac arrest
- But use O2 at the highest concentration (i.e. 100%) during initial resuscitation
- Titrate Oxygen after ROSC to limit the risk of hyperoxemia
- Maintain SpO2 $\geq$95% (Van de Louw, 2001-Seguin, 2000)

Hypothermia in children

ERC Guidelines 2010

- Better neurologic outcome
  - In adults after VF (Bernard-2002; MHACASG-2002)
  - In asphyxic NB (Gluckman-2005; Shankaran-2005)
- In paediatric CA observational neither supports nor refutes (Doherty-2009)
  - Cold patients were younger and sicker



ClinicalTrials.gov
A service of the U.S. National Institutes of Health

Home Search Study Topics Glossary

Search

Study 9 of 67 for search of: hypothermia and children

Previous Study Return to Search Results Next Study

Full Text View | Tabular View | No Study Results Posted | Related Studies

Therapeutic Hypothermia to Improve Survival After Cardiac Arrest in Pediatric Patients-THAPCA-OH [Out of Hospital] Trial

This study is currently recruiting participants.
Verified December 2011 by University of Michigan

First Received on April 8, 2009. Last Updated on December 5, 2011 History of Changes

Sponsor:	University of Michigan
Collaborator:	National Heart, Lung, and Blood Institute (NHLBI)
Information provided by (Responsible Party):	Frank W. Moler, M.D, M.S, University of Michigan
ClinicalTrials.gov Identifier:	NCT00878644

Duration of Hypothermia for Neuroprotection After Pediatric Cardiac Arrest

This study is currently recruiting participants.
Verified August 2011 by University of Pittsburgh

First Received on November 24, 2008. Last Updated on August 5, 2011 History of Changes

Sponsor:	University of Pittsburgh
Collaborators:	National Institute of Neurological Disorders and Stroke (NINDS) Laerdal Medical **Children**'s Hospital of Pittsburgh
Information provided by:	University of Pittsburgh
ClinicalTrials.gov Identifier:	NCT00797680

PAEDIATRIC GUIDELINES 2010

Post ROSC

Child in coma after CPA

- may benefit from being cooled
- to a core T °32-34°C for at least 24 h.
- should not be actively rewarmed unless < 32°C.
- rewarm the child slowly at 0.25-0.5°C h^{-1}

ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Survival in children

ERC Guidelines 2010

Berens RJ et al.

Probability of survival based on etiology of cardiopulmonary arrest in pediatric patients.

Paediatr Anaesth 2010;doi: 10.1111/j.1460-9592.2010.03479.x

PAEDIATRIC GUIDELINES 2010

Survival after cardiac arrest

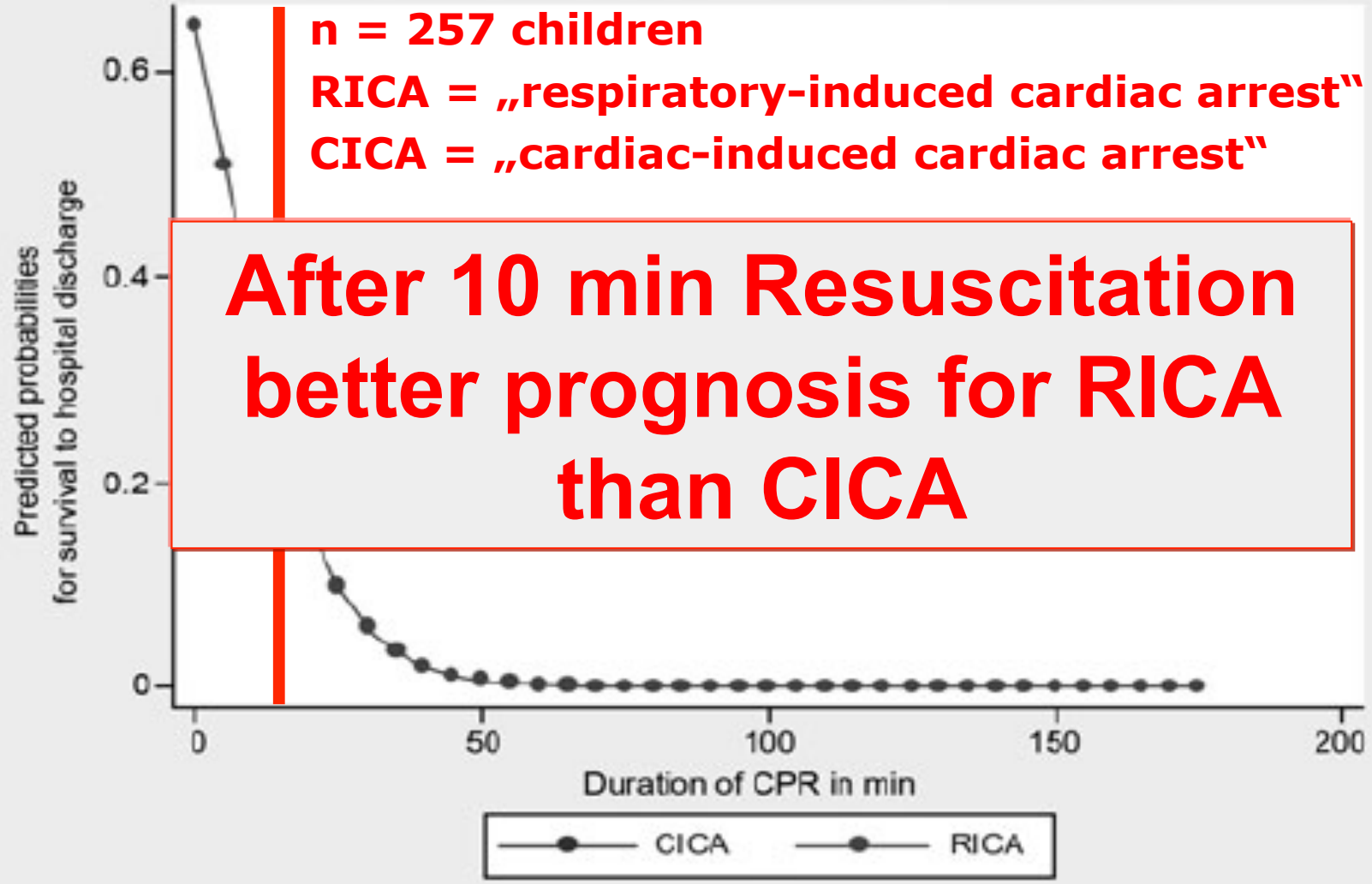
ERC Guidelines 2010

n = 257 children

RICA = „respiratory-induced cardiac arrest"

CICA = „cardiac-induced cardiac arrest"

After 10 min Resuscitation better prognosis for RICA than CICA



Intraosseous access

Emergency intraosseous access in a helicopter emergency medical service: a retrospective study.

Sunde GA et al., Scand J Trauma Resusc Emerg Med 2010; 18: 52

ERC Guidelines 2010

ORIGINAL RESEARCH Open Access

Emergency intraosseous access in a helicopter emergency medical service: a retrospective study

Patient age	Number of patients who recieved IO	Total number of patients treated	IO insertion rate %
0-2 years	18	453	3.97%
3-6 years	0	198	0.00%
7-17 years	5	486	1.03%
18-78 years	47	4979	0.94%

(78 attempts n = 70, 7 days- 78 years)

Sunde GA et al., Scand J Trauma Resusc Emerg Med 2010; 18: 52

ORIGINAL RESEARCH Open Access

Emergency intraosseous access in a helicopter emergency medical service: a retrospective study

IO device	Number of patients who recieved IO	Number of insertions	First attempt success ** (95%C	Overall success *** (95%CI)
Manual needle	5*	6	40% (5-85)	50% (12-88)
B.I.G.	18*	22	56% (31-79)	55% (32-76)
EZ-IO	49	50	96% (86-100)	96% (86-100)
Total number	70*	78	84%	81%

Sunde GA et al., Scand J Trauma Resusc Emerg Med 2010; 18: 52

ERC Guidelines 2010

Summary

- Few changes in Paediatric resuscitation
- Push and fast and completely release the chest
- Children need breaths
- Use AED and ET CO2
- Post-resuscitation care : therapeutic hypothermia, titrate oxygen, avoid hyperthermia…..

PAEDIATRIC GUIDELINES 2010

Implementation : courses

- European Paediatric Life Support
  - Manual + Instructor's manual

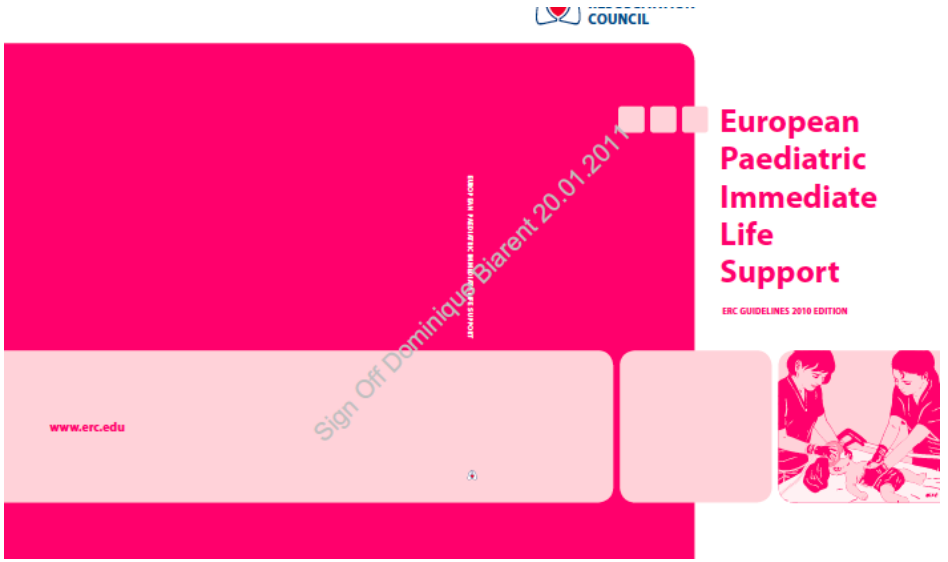
ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Implementation : courses

- European Paediatric Life Support
  - Manual + Instructor's manual
- European Paediatric Immediate Life support
  - Manual + Instructor's manual

ERC Guidelines 2010



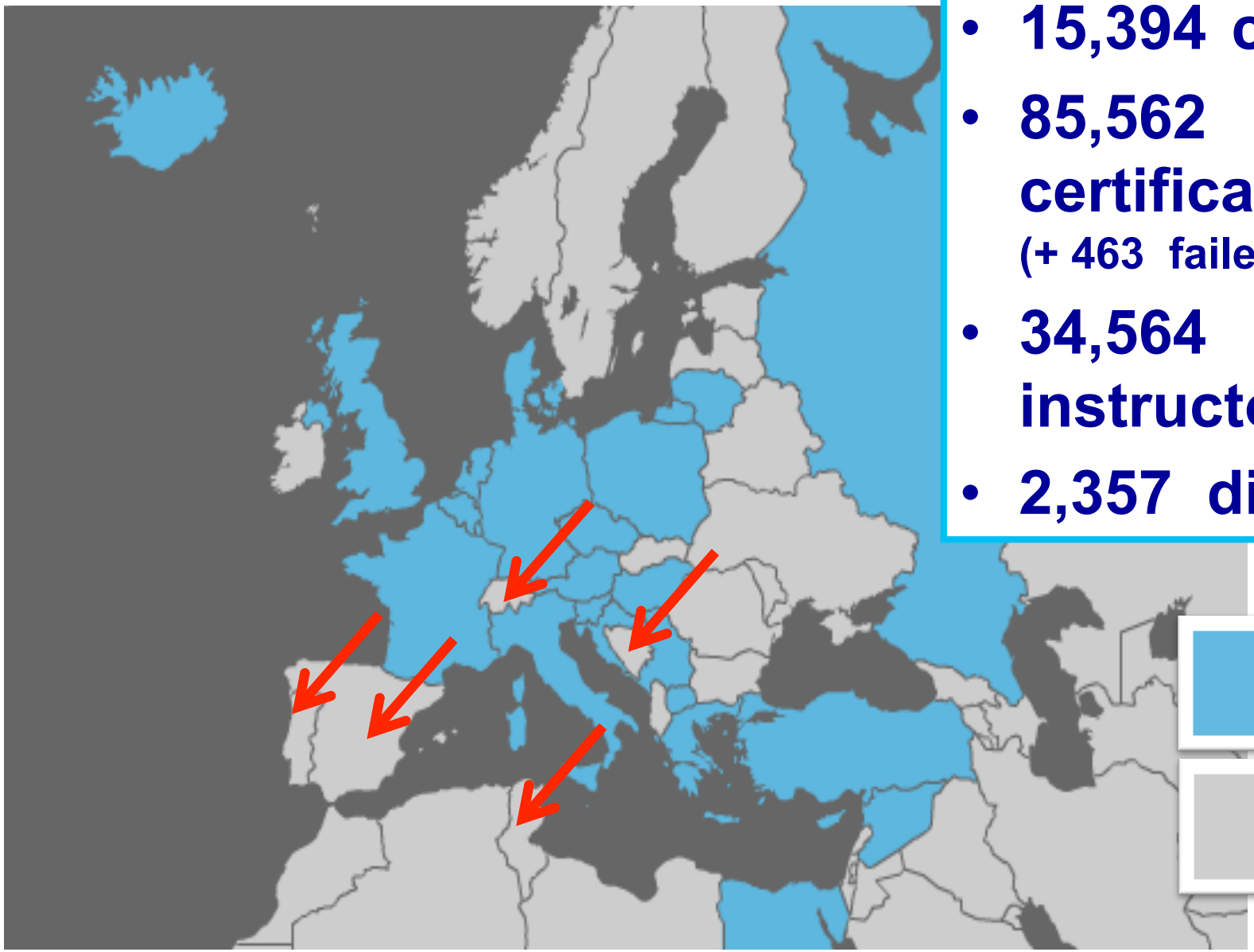
ERC Guidelines 2010

PAEDIATRIC GUIDELINES 2010

Implementation : courses

- European Paediatric Life Support
  - Manual + Instructor's manual
- European Paediatric Immediate Life support
  - Manual + Instructor's manual
- European Neonatal Life support
  - Manual

ERC Courses – Statistics 2011

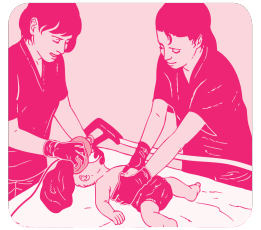


- 15,394 courses
- 85,562 certificates (+ 463 failed)
- 34,564 instructors
- 2,357 directors

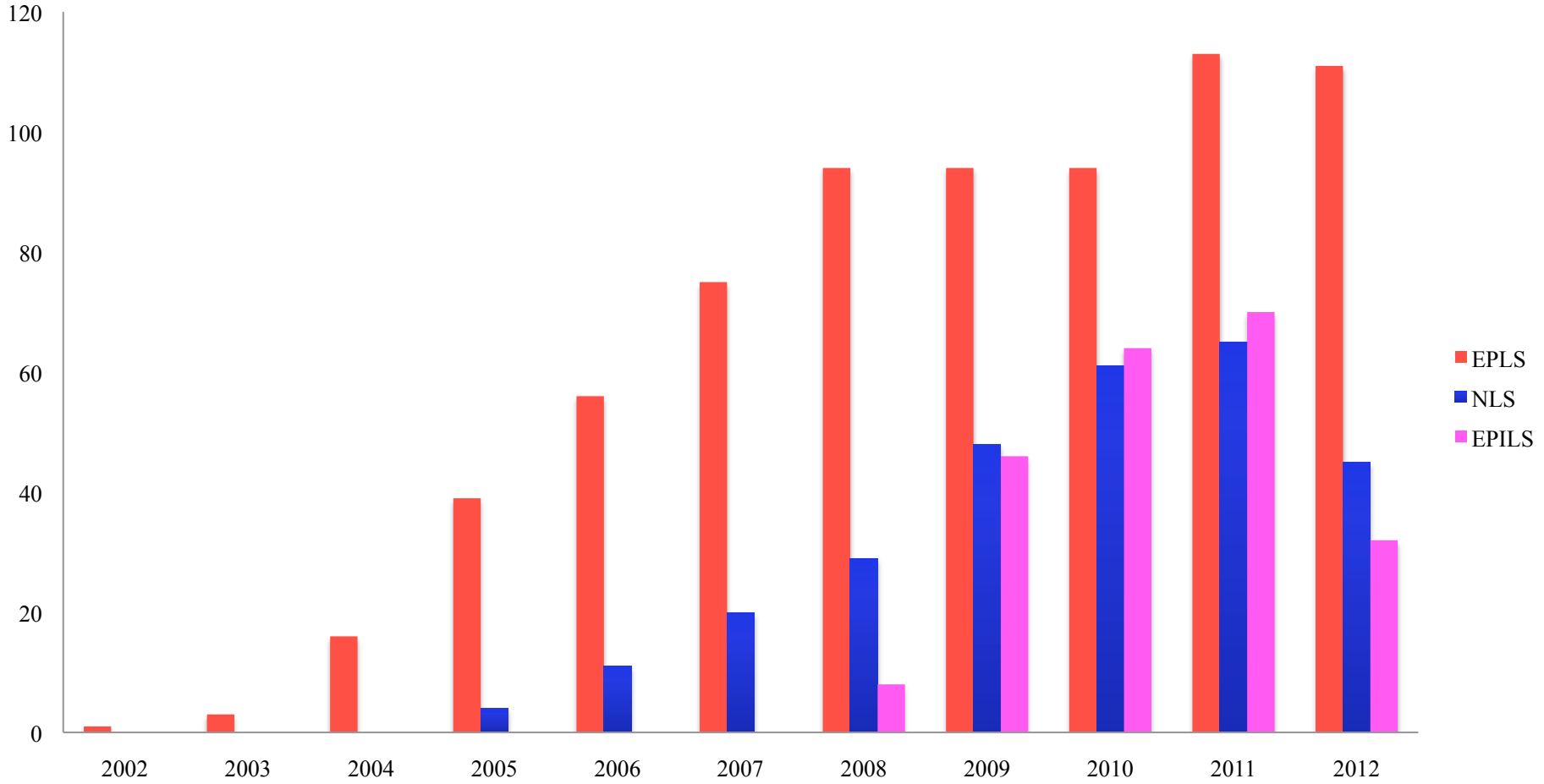
= countries running ERC courses in 2011

= countries not yet running ERC courses in 2011

NLS EPLS EPILS



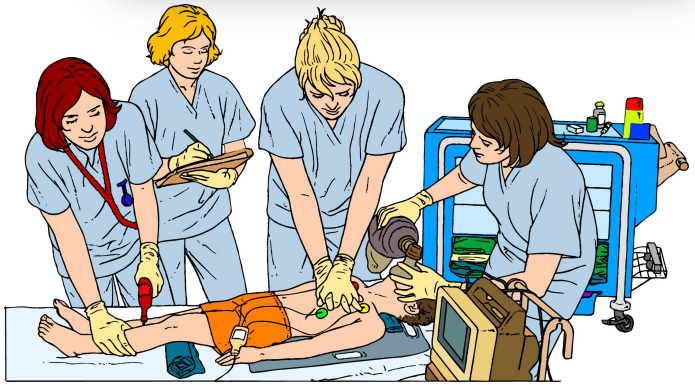
CMS : http:// courses.erc.edu



PAEDIATRIC GUIDELINES 2010

EPILS course

- One day course
- Dedicated to non-emergency physicians, nurses, technicians, students, educators…..
- Aimed to the first 1-5 minutes of
  - Cardiorespiratory arrest
  - Shock
  - Respiratory insufficiency
- Waiting MET or CA team

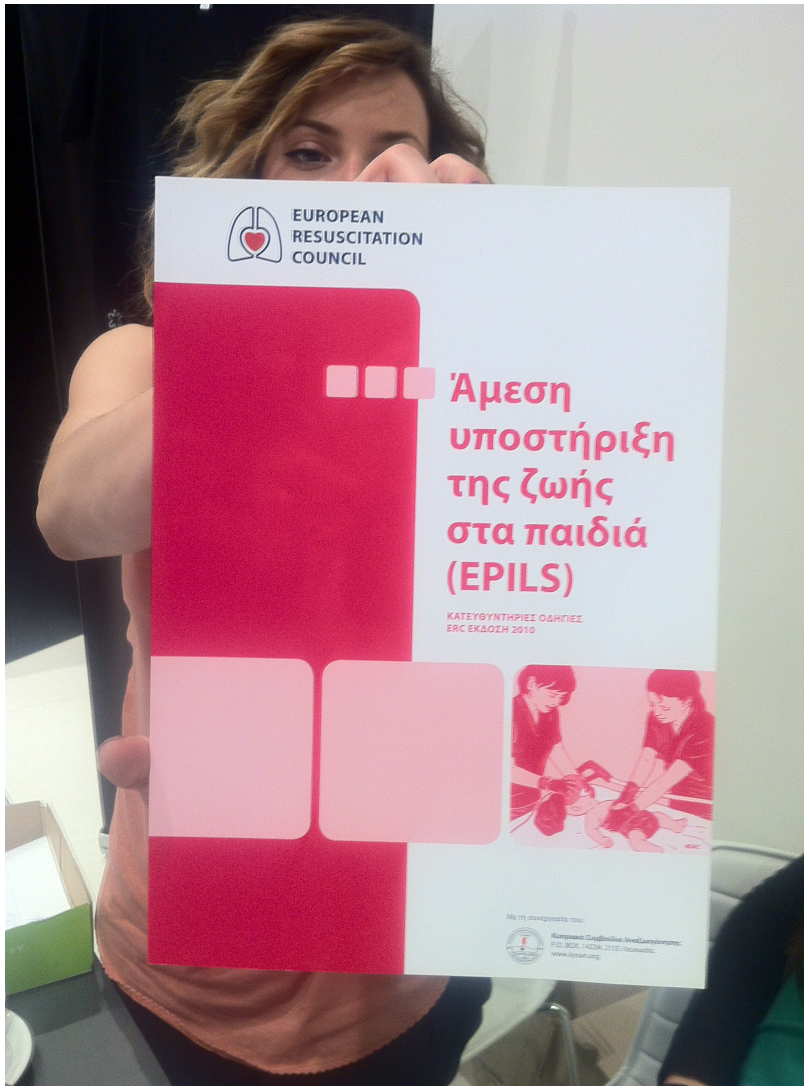


ERC Guidelines 2010

ERC Guidelines 2010

NEW GUIDELINES 2010

Implementation : translations



EPLS Manual

- English
- French
- Spanish
- Portuguese

EPILS Manual

- English
- French
- Greek
- Italian
- Portuguese

European Resuscitation Council

To preserve human life by making high quality resuscitation available to all

NEW GUIDELINES 2010

RESUSCITATION

18|19|20 October

2012

Vienna | Austria

www.resuscitation2012.eu

European Resuscitation Council

2-3 MAY 2013 GHENT BELGIUM

THE FIRST EUROPEAN PEDIATRIC RESUSCITATION & EMERGENCY MEDICINE CONGRESS

www.PREM2013.be

ENDORSED BY ERC, EUSEM, EAP, ESA, ESPA AND SEVERAL NATIONAL SOCIETIES