Get With The Guidelines-Resuscitation Presents:

Significance of CPC/PCPC Scores in Resuscitation

Presenter: Todd Sweberg, MD, MBA

December 15, 2017
12:00pm – 1:00pm Central

Our Presenter

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Disclosures

- I have no financial disclosures or conflicts to report.

Aims

- Discuss development of Cerebral Performance Category (CPC) and Pediatric Cerebral Performance Category (PCPC) scores
- Review significant GWTG articles relying on CPC/PCPC
- Discuss utilization and reliance of GWTG research on CPC/PCPC
- Present trends in CPC/PCPC documentation in the GWTG database

Cerebral Performance Category

Assessment of outcome after severe brain damage: a practical scale

B Jennett, M Bond - The Lancet, 1975

Cited 7220 times

CPC Scale

Cerebral Performance Categories Scale

CPC Scale

Note: If patient is anesthetized, paralyzed, or intubated, use "as is" clinical condition to calculate scores.
CPC 1. Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychologic deficit.
CPC 2. Moderate cerebral disability: conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.
CPC 3. Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.
CPC 4. Coma or vegetative state: any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.
CPC 5. Brain death: apnea, areflexia, EEG silence, etc.

Safar P. Resuscitation after Brain Ischemia, in Grenvik A and Safar P Eds: Brain Failure and Resuscitation, Churchill Livingstone, New York, 1981; 155-184.

Eds – Brain Failure and Resuscitation, Churchill Livingstone, New York, 1981; 155-184.

Assessing the outcome of pediatric intensive care

Debra Henry Fiser, MD

In this study it has been demonstrated that the POPC and PCPC scales are both reliable and valid for the measurement of short-term morbidity in children after pediatric intensive care. They are also responsive, detecting longitudinal changes in status during the term of hospitalization.[12]

Cited 467 times

(J PEDIATR 1992;121:68-74)

Pediatric/Neonatal CPC

Pediatric/Neonate Cerebral Performance Categories/PCPC Scale

- **PCPC 1** : Normal - Age-appropriate level of functioning; preschool child developmentally appropriate; school-age child attends regular classes.
- **NEONATE** : Normal - No obvious neurological abnormalities.

- **PCPC 2** : Mild cerebral disability - Able to interact at an age-appropriate level; minor neurological disease that is controlled and does not interfere with daily functioning (e.g., seizure disorder that is well controlled with medication); preschool child may have minor developmental delays, but more than 75% of all daily living developmental milestones are above the 10 th percentile; school-age child attends regular school, but grade is not appropriate for age, or child is failing appropriate grade because of cognitive difficulties.
- **NEONATE** : Mild cerebral disability - Minor neurological abnormality; neurological disease that is controlled and does not interfere with daily functioning (e.g., seizure disorder that is well controlled with medication).

- **PCPC 3** : Moderate cerebral disability - Below age-appropriate functioning; neurological disease that is not controlled and severely limits activities; most activities of preschool child's daily living developmental milestones are below the 10th percentile; school-age child can perform activities of daily living, but attends special classes because of cognitive difficulties and/or has a learning deficit.
- **NEONATE** : Moderate cerebral disability - Neurological disease that is not controlled (e.g., breakthrough seizures despite medications which affect responsiveness to environment).

- **PCPC 4** : Severe cerebral disability - Preschool child's activities or daily living milestones are below the 10th percentile, and child is excessively dependent on others for provision of activities of daily living; school-age child may be so impaired as to be unable to attend school; school-age child is dependent on others for provision of activities of daily living; abnormal motor movements for both preschool and school-age child may include non-purposeful, decorticate, or decerebrate responses to pain.
- **NEONATE** : Severe cerebral disability - Obvious severe neurological disorder: Abnormal motor movements may include non-purposeful, decorticate or decerebrate response to pain.

- **PCPC 5** : Coma or vegetative state - Coma; unawareness.
- **NEONATE** : Coma or vegetative state - Coma; unawareness.

- **PCPC 6** : Brain death
- **NEONATE** : Brain death

CPC/PCPC

- Most sites don’t chart this in the medical record
  - **You need to “calculate” it !!**
- It is easy to calculate!
  - **Don’t check undocumented in the GWTG forms because it isn't written in the medical record**
  - **Only score as not documented if there is no information in the chart to help you score it (which would be really, really, really, unusual)**
- Even if there is not data on admit to score the CPC/PCPC, there will be some on discharge
  - **There should always be a discharge CPC/PCPC!**

Resuscitation Patient Management Tool® **May 2015**

Admission & Discharge

Note: Optional data elements appear in the Get With The Guidelines ® - Resuscitation PMT as dark grey shaded areas.

1.1 Admission Data *Admission Tab*

System Entry Date/Time:___/___/_____ ___:___ ❑ Time Not Documented

Born this admission (or transferred from birth hospital)? ❑ Yes ❑ No

Date/Time of Birth: ___/___/_____ ___:___ ❑ DOB Unknown/Not Documented ❑ Time Not Documented

Age at System Entry: _____ in years | months | weeks | days | hours | minutes ❑ Estimated? ❑ Age Unknown/Not Documented

Gender:
❑ Male ❑ Female ❑ Unknown

Race:
❑ American Indian or Alaska Native ❑ Black or African American ❑ White
❑ Asian ❑ Native Hawaiian or Pacific Islander ❑ UTD

OPTIONAL:
❑ Asian Indian
❑ Chinese
❑ Filipino
❑ Japanese
❑ Korean
❑ Vietnamese
❑ Other Asian

OPTIONAL:
❑ Native Hawaiian
❑ Guamanian or Chamorro
❑ Samoan
❑ Other Pacific Islander

Hispanic Ethnicity:
❑ Yes
❑ No/UTD

Optional, If Yes:
❑ Mexican, Mexican American, Chicano/a
❑ Puerto Rican
❑ Cuban
❑ Another Hispanic, Latin or Spanish Origin

Birth Weight (patients <30 days old only):_____ Units: ❑ pounds ❑ kilograms ❑ grams ❑ Birth Weight Unknown/Not Documented
❑ Weight same as birth weight
Weight (required for pediatric and newborn/neonate patients only):_____ Units: ❑ pounds ❑ kilograms ❑ grams ❑ Weight Unknown/ND

Length (patients <30 days old only):_____ Units: ❑ inches ❑ centimeters ❑ Length Unknown/Not Documented
Head Circumference (patients <30 days old only):_____ Units: ❑ inches ❑ centimeters ❑ Circum. Unknown/Not Documented

CPC/PCPC Scoring Definitions

Admission CPC: _____ ❑ Unknown/Not Documented/Not Applicable

Admission PCPC: _____ ❑ Unknown/Not Documented/Not Applicable (newborn)

Adult Cerebral Performance Categories/CPC Scale	1 Good cerebral performance 2 Moderate cerebral disability 3 Severe cerebral disability 4 Coma or vegetative state 5 Brain death
Pediatric/Neonate Cerebral Performance Categories/PCPC Scale	1 Normal 2 Mild cerebral disability 3 Moderate cerebral disability 4 Severe cerebral disability 5 Coma or vegetative state 6 Brain death

CPC/PCPC Scoring Definitions

Admission CPC: _____ ❑ Unknown/Not Documented/Not Applicable

Admission PCPC: _____ ❑ Unknown/Not Documented/Not Applicable (newborn)

Adult Cerebral Performance Categories/CPC Scale	1 Good cerebral performance 2 Moderate cerebral disability 3 Severe cerebral disability 4 Coma or vegetative state 5 Brain death
Pediatric/Neonate Cerebral Performance Categories/PCPC Scale	1 Normal 2 Mild cerebral disability 3 Moderate cerebral disability 4 Severe cerebral disability 5 Coma or vegetative state 6 Brain death

Outcome Scores and GWTG-Resuscitation

For patients that are less than 30 days old at the time of system entry date, enter the patient's head circumference. Indicate *"inches"* or *"centimeters."* If multiple head circumference measurements are documented, enter the first documented head circumference. If head circumference is not documented, select *"Unknown/Not Documented."*

CPC/PCPC S

Admission CP

Admission PC

Show/Hide

Admission CPC

Admission PCPC

Using the CPC/PCPC Scale (see Scoring Definitions), enter the patient's Cerebral Performance Category (Adults – Age > 18) or Pediatric Cerebral Performance Category (Pediatrics – Age < 18). If the CPC/PCPC is not documented AND *cannot* be calculated from information in medical record, select the *"Unknown/Not Documented"* option. The intent of this data element is to determine the patient's cognitive function prior to the index event.

Admission scoring is based on the following:

- *Hospital Inpatients* : Time of hospital admission.
- *ED Patients* : Time of ED admission.
- *Ambulatory/Outpatient* : Time of ambulatory registration.
- *Newborns age greater than 24 hr* : Immediately prior to event.
- *Newborns in the delivery room and/or age less than 24 hr* : No score should be entered.
- *Rehab facility, SNF, Mental Health inpatients (separate admission)* : Immediately prior to event.
- *Visitor/Employee* : Immediately prior to event.

Adult Cerebral Performance Categories/CPC Scale

The Adult CPC scale is defined by the following:

- **CPC 1** : Good cerebral performance* – Conscious, alert, able to work, might have mild neurologic or psychologic deficit.
- **CPC 2** : Moderate cerebral disability* – conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.
- **CPC 3** : Severe cerebral disability – Conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.
- **CPC 4** : Coma or vegetative state – Any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.
- **CPC 5** : Brain death – Apnea, areflexia, EEG silence, etc.

Pediatric/Neonate Cerebral Performance Categories/PCPC Scale

The pediatric/neonate PCPC scale is defined by the following:

- **PCPC 1** : Normal - Age-appropriate level of functioning; preschool child developmentally appropriate; school-age child attends regular classes.
- **NEONATE** : Normal - No obvious neurological abnormalities

If patient di

Was Life Sup
Withdrawn?

Were organs

If patient su

CPC at Disch

PCPC at Disc

Show/Hide

17 08:49:14 GMT-04:00

CPC/PCPC in the literature

- Surrogate for long term survival
- Measure of therapeutic effectiveness
- Prognostic value
  - Pre arrest
  - Post arrest
- Hypothesis generation

- **Changes in practice!**

Does induction of hypothermia improve outcomes after in-hospital cardiac arrest?☆

Graham Nichol[a,b,*], Ella Huszti[a], Francis Kim[a,c], Deborah Fly[a], Sam Parnia[d],

A Validated Prediction Tool for Initial Survivors of In-Hospital Cardiac Arrest

Duration of resuscitation efforts and survival after in-hospital cardiac arrest: an

Zachary D Goldberger, Paul S Chan, Robert A Berg, Steven L Kronick, Harlan M Krumholz, Brahmajee K Nallamothu, for the American Heart National Registry of Cardiopulmonary Resuscitation) Investigators*

Hospital Variation in Time to Epinephrine for Non-Shockable In-Hospital Cardiac Arrest

Running Title: *Khera et al.; Hospital Epinephrine Use Variation*

Rohan Khera, MD[1]; Paul S. Chan, MD, MSc[2]; Michael Donnino, MD[3,4]; Saket Girotra, MD, SM[5]

For the American Heart Association's Get With The Guidelines-Resuscitation Investigators

John A. Spertus, MD, MPH; Harlan M. Krumholz, MD, SM; Robert A. Berg, MD; son, MD, MPH; Brahmajee K. Nallamothu, MD, MPH;

Women of child-bearing age have better i survival outcomes than do equal-aged me

Early Cardiac Arrest in Patients Hospitalized With Pneumonia

A Report From the American Heart Association's Get With the Guidelines-Resuscitation Program (line) in patients

rhythm in hospital: Hospital Process Composite Outcomes

Time to invasive airway placement and cardiopulmonary arrest☆

Matthew Outcomes of Critically Ill Pat Cardiopulmonary Resuscitat Alignment of D Patients' Likelihood of Favorable Neurologi After In-Hospital Cardiac Arrest

propensity score matched analysis

Lars W Andersen,[1,2,3] Tobias Kurth,[4] Maureen C Clifton Callaway,[7] Michael W Donnino[1,5] for the Guidelines-Resuscitation Investigators

Long-Term Out of In-Ho

Physiologic Monitoring of CPR Quality During Adult Cardiac Arrest: A Propensity-Matched Cohort Study

Robert M. Sutton, MD MSCE[1], Benjamin French, PhD[2], Peter A. Meaney, MD MPH[1], Alexis A. Topjian, MD MSCE[1], Christopher Parshurum, MBChB D.Phil[3], Dana P. Edelson, MD MS[4], Stephen Schexnayder, MD[5], Benjamin S. Abella, MD MPhil[6], Raina M. Merchant, MD MSHP[6], Melania Bembea, MD[7], Robert. A. Berg, MD[1], Vinay M. Nadkarni, MD MS[1], and for the American Heart Association's Get With The Guidelines – Resuscitation Investigators

Victor Novack[3,4], Michael W Donnino[1,5*] and for the American Heart Association's Get With The Guidelines*-Resuscitation Investigators

Effectiveness of cardioverter-de inhospital cardiac arrest

Timothy J. Fendler, MD, MS; John A. Spertus, MD, MPH; Kevin F. Kennedy, MS; Lena M. Chen, MD, MS; Sarah M. Perman, MD, MSCE; Paul S. Chan, MD, MSc; for the American Heart Association's Get With the Guidelines–Resuscitation Investigators

Paul S. Chan, MD, MSc,[a,b] Harlan M. Krumholz, MD, SM,[c,d] John A. Spertus, MD, MPH,[a,b] Lesley H. Curtis, Yan Li, PhD,[a] Bradley G. Hammill, MS,[c] and Brah Association's Get With the Guidelines–Resuscitatio *Duke University School of Medicine, Durham, NC; Development Center of Excellence; and Ann Arbor,* M.D., S.M.[4], Lesley H. Curtis, Ph.D.[5], Yan Li, P Spertus, M.D., M.P.H.[1,2], and for the American Heart Association's Get With The Guidelines®-Resuscitation Investigators*

Association Between Therapeutic Hypothermia and Survival After In-Hospital Cardiac Arrest

Paul S. Chan, MD; Robert A. Berg, MD; Yuanyuan Tang, PhD; Lesley H. Curtis, PhD; John A. Spertus, MD, MPH; for the American Heart Association's Get With the Guidelines–Resuscitation Investigators

ation ng In-Hospital Cardiac Arrest

MS; Brahmajee K. Nallamothu, MD, MPH; Chan, MD, MSc; J. Randall Curtis, MD, MPH; e American Heart Association's Get With the Guidelines–Resuscitation Investigators*

CPC as a primary or secondary outcome

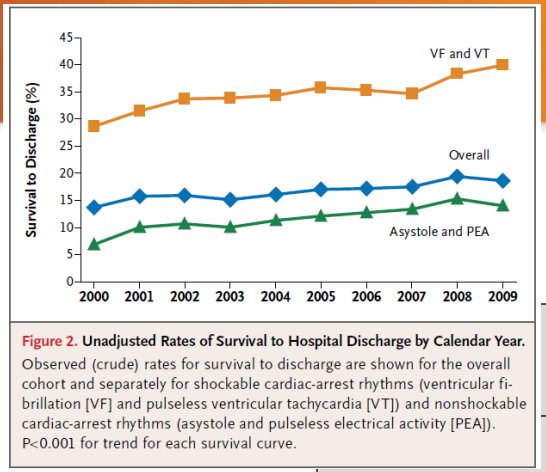


Figure 2. Unadjusted Rates of Survival to Hospital Discharge by Calendar Year.
Observed (crude) rates for survival to discharge are shown for the overall cohort and separately for shockable cardiac-arrest rhythms (ventricular fibrillation [VF] and pulseless ventricular tachycardia [VT]) and nonshockable cardiac-arrest rhythms (asystole and pulseless electrical activity [PEA]). P<0.001 for trend for each survival curve.

	2003-2010	2010-2012	2013-2016
CPC	7	10	15
Total	17	21	30
%	41%	48%	50%

N Engl J Med 367;20

Cardiopulmonary resuscitation of adults in the hospital: A report of 14 720 cardiac arrests from the National Registry of Cardiopulmonary Resuscitation

Mary Ann Peberdy *, William Kaye, Joseph P. Ornato, Gregory L. Larkin, Vinay Nadkarni, Mary Elizabeth Mancini, Robert A. Berg, Graham Nichol, Tanya Lane-Trultt, for the NRCPR Investigators

- First publication from NRCPR
  - (later named GWTG)
- Goals: … "describe the NRCPR and provide the first comprehensive, Utstein-based, standardized characterization of in-hospital resuscitation in the United States."
- Analysis of 14,720 adult arrests

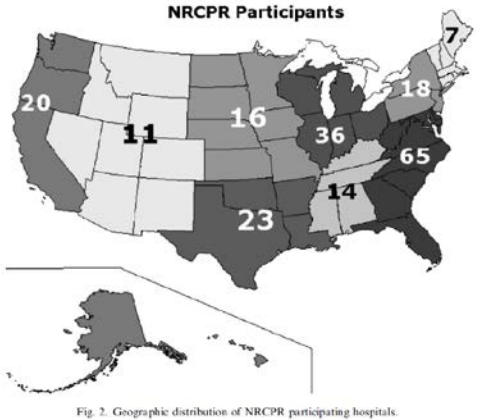


Fig. 2. Geographic distribution of NRCPR participating hospitals.

Resuscitation 58 (2003) 297/308

Table 1
Patient Characteristics

N	14 720
Age (y)	
Mean ± S.D.	67.6 ± 15.4
Median (25th, 75th)	70 (58, 79)
Range	18–111
Sex	57% M, 43% F
Race/ethnicity	
White	71%
Black	21%
Hispanic	5%
Other	2%
Subject type	
Inpatient	88%
ED	12%
Ambulatory/outpatient	0.8%
Visitor or employee	0.2%
Illness category	
Medical, cardiac	51%
Medical, noncardiac	39%
Surgical, noncardiac	10%
Surgical, cardiac	7%
Trauma	3%
Other	1%
Pre-existing conditions	
MI (this or prior admission)	36%
Respiratory insufficiency	35%
CHF (this or prior admission)	34%
Arrhythmia	29%
Renal insufficiency	29%
Diabetes mellitus	28%
Pneumonia/septicemia/other infection	26%
Hypotension/hypoperfusion	24%
Metabolic/electrolyte abnormality	21%
Baseline depression in CNS function	11%
Metastatic or hematologic malignancy	10%
None	6%
Hepatic insufficiency	6%
Acute CNS non-stroke event	5%
Acute stroke	4%
Major trauma	3%
Toxicological problem	2%
Interventions in place before code	
Vascular access	90%
ECG monitor	71%
Pulse oximeter	53%
Invasive airway	27%
Intravenous vasoactive agent	21%
Assisted or mechanical ventilation	20%
Intra-arterial catheter	8%
Intravenous antiarrhythmic medication	6%
Pulmonary artery catheter	5%
Pacemaker, internal	5%
Dialysis or extracorporeal filtration	3%
Chest tube	3%
Pacemaker, transcutaneous	2%
Intra-aortic balloon pump	1.6%
ICD	1.2%

Table 2
Index event characteristics

Event location	
ICU	48%
Inpatient	32%
ED	11%
Diagnostic area	4%
Operating room	2%
PACU	0.5%
Outpatient	0.4%
Other	2.1%
First documented rhythm	
VF/VT	24%
PEA	30%
Asystole	36%
Unknown by documentation	9%
Witnessed arrest (from code documentation)	
Witnessed and/or monitored	86%
Witnessed and monitored	66%
Witnessed and not monitored	11%
Monitored and not witnessed	9%
Unwitnessed and unmonitored	5%
Immediate cause(s) of event (present within 1 h before arrest)	
Arrhythmia	49%
Acute respiratory insufficiency or compromise	37%
Hypotension	32%
Cardiogenic pulmonary edema	10%
Metabolic/electrolyte disturbance	10%
Acute pulmonary edema	3%
Acute pulmonary embolism	2%
Airway obstruction	2%
Toxicological problem	1%

includes data on >14 000 adult, in-hospital cardiac arrests from >200 US hospitals.

[illegible] quality-improvement tool for hospitals that allows them to compare their performance against other institutions nationally and regionally. It allows participating hospitals to [illegible] services over time. The NRCPR is also a data resource for the AHA Emergency Cardiovascular Care Committee, allowing it to develop evidence-based resuscitation guidelines and to track the adoption and impact of these guidelines into new clinical practice.

4.1. Hospital and emergency team characteristics

The NRCPR hospitals participating in this study do not represent a random sample of US hospitals, although the relationship between the characteristics of these hospitals and those of general US hospitals is known. Compared with the average US acute medical/surgical hospital, NRCPR hospitals have a larger mean number of beds (277 vs 152) [42]. A significantly greater proportion of NRCPR facilities have >500 beds (15.7%

Table 3
Treatment characteristics and percentage of patients who received specific treatments

Table 5
Treatment characteristics of VF or pulseless VT arrests

Table 6
Neurological and functional status of survivors

	Preadmission (%)	Postdischarge (%)
Residence		
Home	84	51.4
Other hospital	8	14
Rehabilitation center	0.6	10.8
Nursing facility	5.2	19.4
Other supervised residence	1	0.7
Hospice	0.2	2.0
Other	1.0	1.7
Cerebral performance category		
(1) Good cerebral performance	68	58.7
(2) Moderate cerebral disability	23.4	26.4
(3) Severe cerebral disability	6.7	11.2
(4) Coma or vegetative state	2	3.6
(5) Brain death	0	0
Overall performance category		
(1) Good performance	48.5	36.7
(2) Moderate disability	36.6	38.3
(3) Severe disability	13	21.4
(4) Coma or vegetative state	2	3.6
(5) Brain death	0	0

"30% of survivors were discharged to either a rehabilitation center or a skilled nursing home when less than 6% had lived in such a facility before their arrest."

It is reassuring that 86% of patients with a Cerebral Performance Category-1 (CPC-1) at the time of admission had a CPC-1 at discharge.

Resuscitation 58 (2003) 297/308

Long-Term Outcomes in Elderly Survivors of In-Hospital Cardiac Arrest

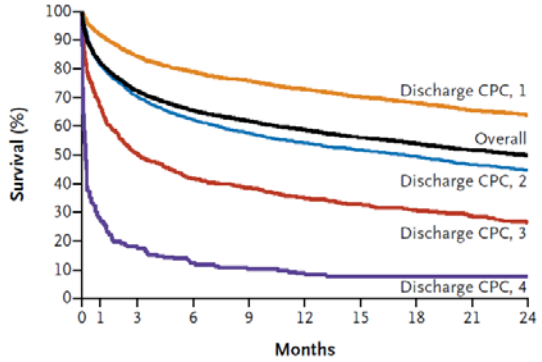
Paul S. Chan, M.D., Brahmajee K. Nallamothu, M.D., M.P.H., Harlan M. Krumholz, M.D., John A. Spertus, M.D., M.P.H., Yan Li, Ph.D., Bradley G. Hammill, M.S., and Lesley H. Curtis, Ph.D., for the American Heart Association Get with the Guidelines–Resuscitation Investigators*

- Get with the Guidelines–Resuscitation registry between January 1, 2000, and December 31, 2008
  - A total of 19,373 patients had a pulseless in-hospital cardiac arrest and survived to discharge
  - 9057 patients who were younger than 65 years of age, leaving 10,316 Medicare age-eligible patients
- Primary outcome: survival and freedom from readmission 1 year after discharge
  - Secondary outcome: Survival and freedom from readmission 2 years after discharge
- Analysis: Multivariable logistic-regression models with generalized estimating equations were used to examine predictors of survival

N Engl J Med 368;11 March 14, 2013

Long-Term Outcomes in Elderly Survivors of In-Hospital Cardiac Arrest

Paul S. Chan, M.D., Brahmajee K. Nallamothu, M.D., M.P.H., Harlan M. Krumholz, M.D., John A. Spertus, M.D., M.P.H., Yan Li, Ph.D., Bradley G. Hammill, M.S., and Lesley H. Curtis, Ph.D., for the American Heart Association Get with the Guidelines–Resuscitation Investigators*



Percent Surviving						
Overall	82.0	72.0	65.4	58.5	53.7	49.6
Discharge CPC, 1	91.7	84.2	78.9	72.8	67.9	63.6
Discharge CPC, 2	81.3	69.9	62.1	54.0	49.1	44.7
Discharge CPC, 3	66.4	49.8	41.5	34.8	30.5	26.3
Discharge CPC, 4	27.2	17.4	12.3	8.2	7.7	7.7

Figure 1. Kaplan–Meier Estimates of Rates of Survival over Time among Patients Who Have Survived an In-Hospital Cardiac Arrest.

Shown below the graph are the estimated rates of survival at specific follow-up time points. The cerebral-performance category (CPC) scores are used to assess neurologic status at discharge after a cardiac arrest. Scores range from 1 to 5, with 1 indicating mild or no neurologic disability, 2 indicating mild neurologic disability, 3 indicating severe neurologic disability, 4 indicating coma or vegetative state, and 5 indicating brain death.

Table 3. Associations between Selected Patient Characteristics and Readmission at 1 Year.*

Variable	Adjusted Hazard Ratio (95% CI)	P Value
Age		
65–74 yr	1.00	—
75–84 yr	1.05 (0.98–1.13)	0.19
≥85 yr	1.06 (0.94–1.19)	0.34
Sex		
Male	1.00	—
Female	1.09 (1.01–1.17)	0.02
Race		
White	1.00	—
Black	1.22 (1.08–1.37)	0.002
Other	0.99 (0.77–1.28)	0.96
Initial cardiac-arrest rhythm		
Pulseless electrical activity	1.00	—
Asystole	0.95 (0.87–1.05)	0.33
Pulseless ventricular tachycardia	1.02 (0.91–1.14)	0.76
Ventricular fibrillation	0.94 (0.85–1.04)	0.20
CPC score at discharge		
1	1.00	—
2	1.23 (1.13–1.35)	<0.001
3	1.29 (1.14–1.46)	<0.001
4	0.86 (0.58–1.28)	0.45

N Engl J Med 368;11 March 14, 2013

Long-Term Outcomes in Elderly Survivors of In-Hospital Cardiac Arrest

Paul S. Chan, M.D., Brahmajee K. Nallamothu, M.D., M.P.H., Harlan M. Krumholz, M.D., John A. Spertus, M.D., M.P.H., Yan Li, Ph.D., Bradley G. Hammill, M.S., and Lesley H. Curtis, Ph.D., for the American Heart Association Get with the Guidelines–Resuscitation Investigators*

- "In conclusion, we found that 59% of elderly survivors of an in-hospital cardiac arrest were alive at 1 year, and one third were not readmitted to the hospital during that time. Survival and readmission rates differed according to the patients' age, sex, race, and **neurologic status at discharge**."

N Engl J Med 368;11 March 14, 2013

Physiologic Monitoring of CPR Quality During Adult Cardiac Arrest: A Propensity-Matched Cohort Study

Robert M. Sutton, MD MSCE[1], Benjamin French, PhD[2], Peter A. Meaney, MD MPH[1], Alexis A. Topjian, MD MSCE[1], Christopher Parshurum, MBChB D.Phil[3], Dana P. Edelson, MD MS[4], Stephen Schexnayder, MD[5], Benjamin S. Abella, MD MPhil[6], Raina M. Merchant, MD MSHP[6], Melania Bembea, MD[7], Robert. A. Berg, MD[1], Vinay M. Nadkarni, MD MS[1], and for the American Heart Association's Get With The Guidelines – Resuscitation Investigators

- "Measurements of myocardial blood flow during CPR are not available to the rescuer"
- "The American Heart Association (AHA)…recommends using surrogates related to myocardial blood flow ($ETCO_2$) or diastolic blood pressure (DBP) to monitor resuscitation quality"

  "…Clinical studies supporting the titration of these parameters during human CPR are lacking"

Resuscitation. 2016 September ; 106: 76–82

Physiologic Monitoring of CPR Quality During Adult Cardiac Arrest: A Propensity-Matched Cohort Study

Robert M. Sutton, MD MSCE[1], Benjamin French, PhD[2], Peter A. Meaney, MD MPH[1], Alexis A. Topjian, MD MSCE[1], Christopher Parshurum, MBChB D.Phil[3], Dana P. Edelson, MD MS[4], Stephen Schexnayder, MD[5], Benjamin S. Abella, MD MPhil[6], Raina M. Merchant, MD MSHP[6], Melania Bembea, MD[7], Robert. A. Berg, MD[1], Vinay M. Nadkarni, MD MS[1], and for the American Heart Association's Get With The Guidelines – Resuscitation Investigators

- Adult patients with a CPR event requiring chest compressions with an invasive airway or arterial catheter in place at the time of arrest
  - Excluded
    - events lasting < 1 minute
    - delivery room events
    - events missing either outcome or variables necessary for propensity matching

Resuscitation. 2016 September ; 106: 76–82

Physiologic Monitoring of CPR Quality During Adult Cardiac Arrest: A Propensity-Matched Cohort Study

Robert M. Sutton, MD MSCE[1], Benjamin French, PhD[2], Peter A. Meaney, MD MPH[1], Alexis A. Topjian, MD MSCE[1], Christopher Parshurum, MBChB D.Phil[3], Dana P. Edelson, MD MS[4], Stephen Schexnayder, MD[5], Benjamin S. Abella, MD MPhil[6], Raina M. Merchant, MD MSHP[6], Melania Bembea, MD[7], Robert. A. Berg, MD[1], Vinay M. Nadkarni, MD MS[1], and for the American Heart Association's Get With The Guidelines – Resuscitation Investigators

- Clinician-reported use of $ETCO_2$ or DBP was associated with improved rates of ROSC
- Survival to hospital discharge and survival with favorable neurological outcome were not different between groups

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- In the subset of events with $ETCO_2$ CPR quality monitoring…

- ETCO2 >10mmHg during CPR was reported in 65% events
- Associated with improved survival to hospital discharge
  - 24% versus 11%; OR 2.41, CI95 1.35 – 4.30, p=0.003
- Improved survival with favorable neurological outcome
  - 18% versus 8%; OR 2.31, CI95 1.31 – 4.09, p=0.004

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- Clinician-reported use of physiologic monitoring of CPR quality with $ETCO_2$ or diastolic blood pressure was associated with an improved rate of ROSC.
  - Survival to hospital discharge and survival with favorable neurological outcome were not different between groups.
- Subset of events where CPR quality was monitored with $ETCO_2$ only
  - Improved rates of patient survival to hospital discharge
  - Improved rates of survival with favorable neurological outcome when ETCO2 was >10mmHg

Resuscitation. 2016 September ; 106: 76–82

Association Between Therapeutic Hypothermia and Survival After In-Hospital Cardiac Arrest

Paul S. Chan, MD; Robert A. Berg, MD; Yuanyuan Tang, PhD; Lesley H. Curtis, PhD; John A. Spertus, MD, MPH;
for the American Heart Association's Get With the Guidelines–Resuscitation Investigators

- 80% of in-hospital cardiac arrests (IHCA) have initial rhythms of asystole or pulseless electrical activity (PEA)
  - Evidence for therapeutic hypothermia is unclear in these rhythms
- Study to evaluate the association of hypothermia treatment
  - Survival to hospital discharge
  - Favorable neurological survival at hospital discharge

JAMA. 2016;316(13):1375-1382

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- Inclusion:
  - ROSC after index in-hospital cardiac
  - Patients on mechanical ventilation at the time of cardiac arrest or after cardiac arrest
- Primary outcome: survival to hospital discharge
- Secondary outcome: favorable neurological survival
  - Survival to hospital discharge with a Cerebral Performance Category score of 1 or 2

JAMA. 2016;316(13):1375-1382

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- 6.0% of patients were treated with therapeutic hypothermia
  - Patients treated with hypothermia were younger
  - Less likely to have a cardiac arrest in the intensive care unit
  - More likely to have an initial cardiac arrest rhythm of ventricular fibrillation
  - More likely to have a myocardial infarction prior to their cardiac arrest
  - Less likely to have hypotension, respiratory insufficiency, renal insufficiency, hepatic insufficiency, pneumonia, acute stroke, and a metastatic or hematologic malignant neoplasm

JAMA. 2016;316(13):1375-1382

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American Heart Association | American Stroke Association. life is why

GET WITH THE GUIDELINES. RESUSCITATION

Table 2. In-Hospital Outcomes and Model Results

Survival	Patients, No./Total No. (%)		Relative Risk With Hypothermia (95% CI)[a]	Risk Difference With Hypothermia, % (95% CI)[a,b]	*P* Value[c]	*P* Value for Interaction[d]
	Hypothermia	No Hypothermia				
Survival to discharge						
All cardiac arrests	417/1524 (27.4)	1084/3714 (29.2)	0.88 (0.80 to 0.97)	−3.6 (−6.3 to −0.9)	.01	
Nonshockable cardiac arrests	247/1112 (22.2)	695/2832 (24.5)	0.87 (0.76 to 0.99)	−3.2 (−6.2 to −0.3)		.74
Shockable cardiac arrests	170/412 (41.3)	389/882 (44.1)	0.90 (0.77 to 1.05)	−4.6 (−10.9 to 1.7)		
Favorable neurological survival[e]						
All cardiac arrests	246/1443 (17.0)	725/3529 (20.5)	0.79 (0.69 to 0.90)	−4.4 (−6.8 to −2.0)	<.001	
Nonshockable cardiac arrests	137/1054 (13.0)	446/2723 (16.4)	0.78 (0.64 to 0.93)	−3.7 (−6.2 to −1.1)		.88
Shockable cardiac arrests	109/389 (28.0)	279/806 (34.6)	0.79 (0.65 to 0.97)	−7.3 (−13.3 to −1.3)		

[a] Both relative risks and absolute risk differences are reported for propensity score–matched cohorts.

[b] Risk difference is calculated as the absolute survival rate with hypothermia treatment minus the rate with no hypothermia treatment.

[c] For comparison of outcomes in the overall cohort.

[d] Interaction between hypothermia and initial cardiac arrest rhythm tests whether the estimates of effect were different in the shockable and nonshockable rhythm subgroups.

[e] Survival to discharge with a Cerebral Performance Category score of 1 or 2. Information on neurological status was not available for 81 hypothermia-treated patients and 185 non–hypothermia-treated patients.

Association Between Therapeutic Hypothermia and Survival After In-Hospital Cardiac Arrest

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- "Among patients IHCA, use of therapeutic hypothermia compared with usual care was associated with a lower likelihood of survival to hospital discharge and a **lower likelihood of favorable neurological survival"**

- "These observational findings warrant a randomized clinical trial to assess efficacy of therapeutic hypothermia for in-hospital cardiac arrest"

JAMA. 2016;316(13):1375-1382

Trends in Survival after In-Hospital Cardiac Arrest

Saket Girotra, M.D., Brahmajee K. Nallamothu, M.D., M.P.H., John A. Spertus, M.D., M.P.H., Yan Li, Ph.D., Harlan M. Krumholz, M.D., and Paul S. Chan, M.D., for the American Heart Association Get with the Guidelines–Resuscitation Investigators

- Despite advances in resuscitation care in recent years, it is not clear whether survival and neurologic function after in-hospital cardiac arrest have improved over time.
- All adults who had an in-hospital cardiac arrest at 374 hospitals in the Get with the Guidelines–Resuscitation registry between 2000 and 2009.
- Using multivariable regression, we examined temporal trends in risk-adjusted rates of survival to discharge.
- Additional analyses explored …and whether they occurred at the expense of greater neurologic disability in survivors

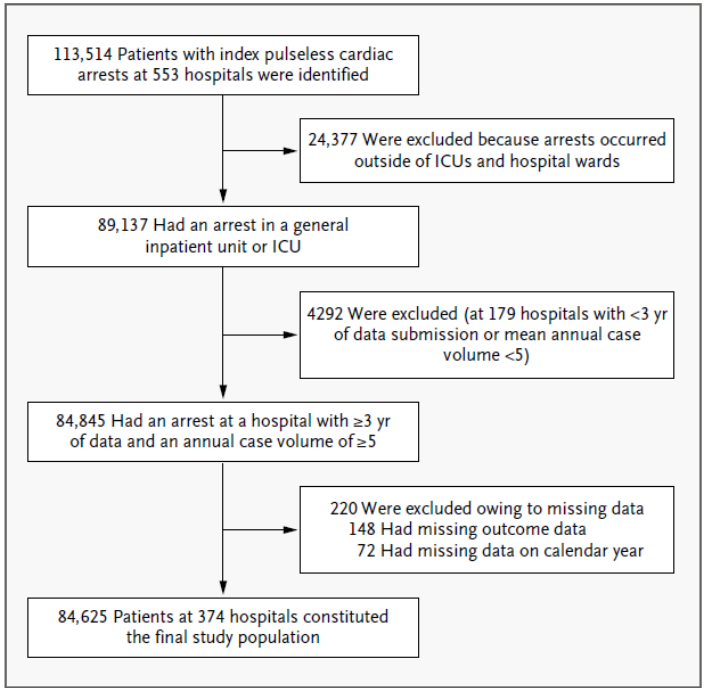

Figure 1. Study Cohort.
ICU denotes intensive care unit.

N Engl J Med 367;20

Table 2. Trends in Survival an

Outcome	Adjusted Rate Ratio per Year (95% CI)‡	P Value for Trend‡
Survival to discharge	04 (1.03–1.06)	<0.001
Acute resuscitation survival§	03 (1.02–1.04)	<0.001
Postresuscitation survival¶	02 (1.01–1.03)	0.001
Neurologic outcome in surviv		
Clinically significant disab	98 (0.97–1.00)	0.02
Severe disability**	01 (0.98–1.04)	0.37

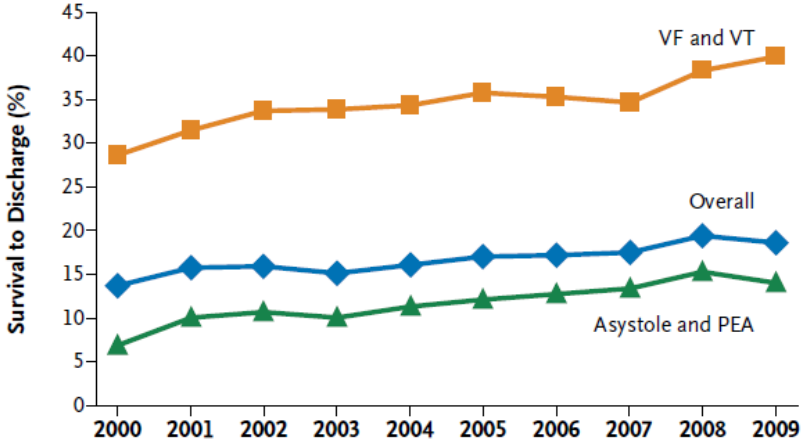

Figure 2. Unadjusted Rates of Survival to Hospital Discharge by Calendar Year.
Observed (crude) rates for survival to discharge are shown for the overall cohort and separately for shockable cardiac-arrest rhythms (ventricular fibrillation [VF] and pulseless ventricular tachycardia [VT]) and nonshockable cardiac-arrest rhythms (asystole and pulseless electrical activity [PEA]). P<0.001 for trend for each survival curve.

N Engl J Med 367;20

Trends in Survival after In-Hospital Cardiac Arrest

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- "In conclusion, we found that survival after in hospital cardiac arrest has improved significantly during the past decade at hospitals participating in a large, national quality-improvement registry."
- "This improvement was accompanied by a parallel decrease in rates of neurologic disability over time."

- "**Data on CPC scores at discharge were missing for 14% of survivors**. …our findings on the secondary outcome of neurologic disability should be interpreted with caution."

N Engl J Med 367;20

Assessing the outcome of pediatric intensive care

Debra Henry Fiser, MD

In this study it has been demonstrated that the POPC and PCPC scales are both reliable and valid for the measurement of short-term morbidity in children after pediatric intensive care. They are also responsive, detecting longitudinal changes in status during the term of hospitalization.[12]

Cited 467 times

(J Pediatr 1992;121:68-74)

Pediatric/Neonatal CPC

Pediatric/Neonate Cerebral Performance Categories/PCPC Scale

- **PCPC 1** : Normal - Age-appropriate level of functioning; preschool child developmentally appropriate; school-age child attends regular classes.
- **NEONATE** : Normal - No obvious neurological abnormalities.

- **PCPC 2** : Mild cerebral disability - Able to interact at an age-appropriate level; minor neurological disease that is controlled and does not interfere with daily functioning (e.g., seizure disorder that is well controlled with medication); preschool child may have minor developmental delays, but more than 75% of all daily living developmental milestones are above the 10 th percentile; school-age child attends regular school, but grade is not appropriate for age, or child is failing appropriate grade because of cognitive difficulties.
- **NEONATE** : Mild cerebral disability - Minor neurological abnormality; neurological disease that is controlled and does not interfere with daily functioning (e.g., seizure disorder that is well controlled with medication).

- **PCPC 3** : Moderate cerebral disability - Below age-appropriate functioning; neurological disease that is not controlled and severely limits activities; most activities of preschool child's daily living developmental milestones are below the 10th percentile; school-age child can perform activities of daily living, but attends special classes because of cognitive difficulties and/or has a learning deficit.
- **NEONATE** : Moderate cerebral disability - Neurological disease that is not controlled (e.g., breakthrough seizures despite medications which affect responsiveness to environment).

- **PCPC 4** : Severe cerebral disability - Preschool child's activities or daily living milestones are below the 10th percentile, and child is excessively dependent on others for provision of activities of daily living; school-age child may be so impaired as to be unable to attend school; school-age child is dependent on others for provision of activities of daily living; abnormal motor movements for both preschool and school-age child may include non-purposeful, decorticate, or decerebrate responses to pain.
- **NEONATE** : Severe cerebral disability - Obvious severe neurological disorder: Abnormal motor movements may include non-purposeful, decorticate or decerebrate response to pain.

- **PCPC 5** : Coma or vegetative state - Coma; unawareness.
- **NEONATE** : Coma or vegetative state - Coma; unawareness.

- **PCPC 6** : Brain death
- **NEONATE** : Brain death

Pediatric GWTG-R: PCPC as a primary or secondary outcome

	2006-2010	2011-2016
PCPC	6	8
Total	9	13
%	67%	62%

Outcomes among neonates, infants, and children after extracorporeal cardiopulmonary resuscitation for refractory inhospital pediatric cardiac arrest: A report from the National

Goals: Use c

- Describe
- Report tr
- Determin

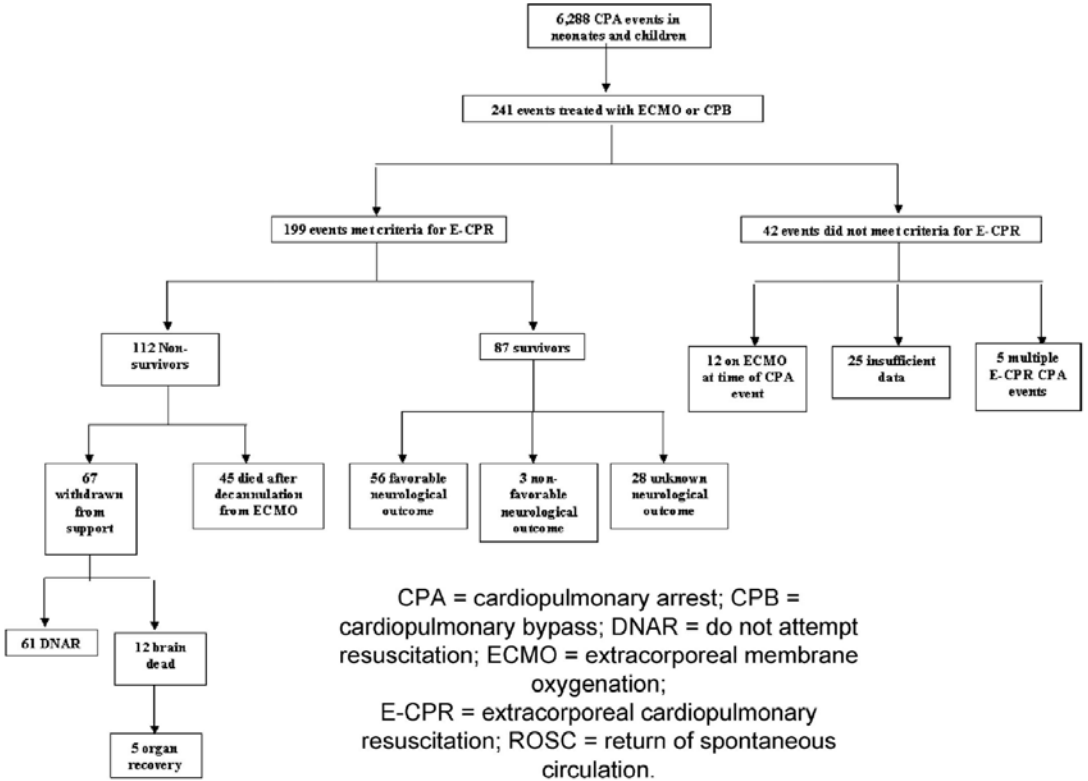

Figure 1. Patient enrollment and outcomes.

Pediatr Crit Care Med 2010 Vol. 11, No. 3

Outcomes among neonates, infants, and children after extracorporeal cardiopulmonary resuscitation for refractory inhospital pediatric cardiac arrest: A report from the National Registry of Cardiopulmonary Resuscitation*

Tia T. Raymond, MD; Christopher B. Cunnyngham, MD; Marita T. Thompson, MD; James A. Thomas, MD; Heidi J. Dalton, MD; Vinay M. Nadkarni, MD; for the American Heart Association National Registry of CPR Investigators

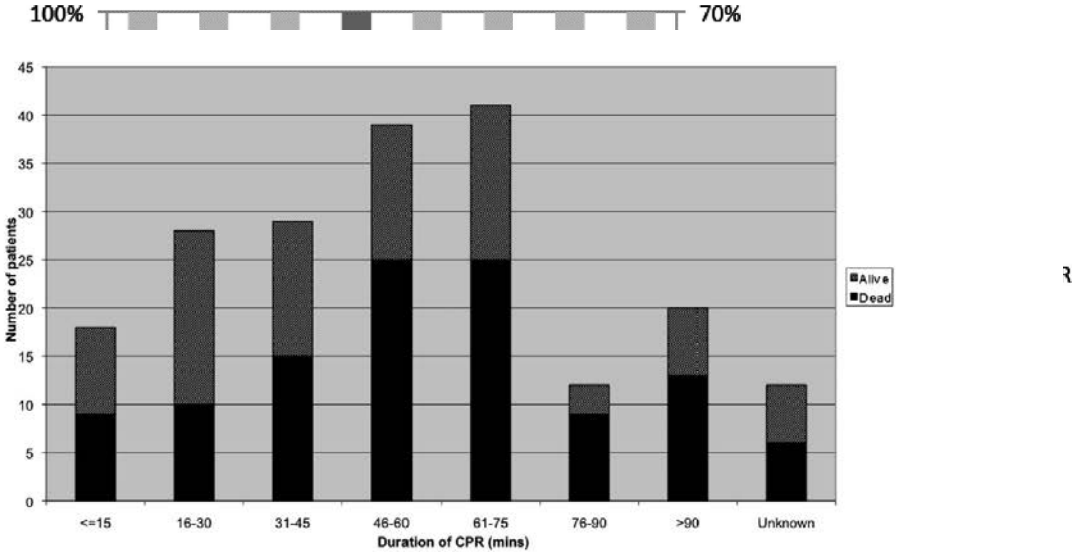

Figure 3. Duration of cardiopulmonary resuscitation (*CPR*) and the number of surviving patients managed with extracorporeal CPR. The duration of CPR was defined as the time from cardiac arrest until the extracorporeal membrane oxygenation pump was started. There was no association with the duration of CPR and survival based on time cut points ($p = .12$).

Figure 2. Trends in extracorporeal cardiopulmonary resuscitation (E-CPR) use and survival based on diagnostic groups from 2000 to 2007. There was no significant change in percent total E-CPR survival rate per year based on Cochran-Armitage trend test ($p = .62$).

Pediatr Crit Care Med 2010 Vol. 11, No. 3

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- "…ECMO is increasingly used to provide blood flow and oxygenation to the patient when resuscitation is unsuccessful…"
  - "May contribute information supportive of the effectiveness in treating select pediatric patients with E-CPR"

- "The vast majority of survivors in this cohort with reported neurologic outcomes were favorable."

	PCPC1	PCPC2	PCPC3
% of Survivors	66%	27%	7%

Pediatr Crit Care Med 2010 Vol. 11, No. 3

Duration of Cardiopulmonary Resuscitation and Illness Category Impact Survival and Neurologic Outcomes for In-hospital Pediatric Cardiac Arrests

Renée I. Matos, MD, MPH; R. Scott Watson, MD, MPH; Vinay M. Nadkarni, MD; Hsin-Hui Huang, MD, MPH; Robert A. Berg, MD; Peter A. Meaney, MD, MPH; Christopher L. Carroll, MD; Richard J. Berens, MD; Amy Praestgaard, MS; Lisa Weissfeld, PhD; Philip C. Spinella, MD; for the American Heart Association's Get With The Guidelines–Resuscitation (Formerly the National Registry of Cardiopulmonary Resuscitation) Investigators

- CPR beyond 20 minutes or with multiple epinephrine doses was considered futile
- Data indicate that some children survive with CPR of increased duration
  - This has not been rigorously evaluated
- Primary outcome: survival to hospital discharge
- Secondary measures
  - return of spontaneous circulation >20 minutes
  - 24-hour survival
  - survival to discharge with favorable neurological outcome (PCPC 1-3, and 1-2)

Circulation; November 14, 2017, Volume 136, Issue 20

Duration of Cardiopulmonary Resuscitation and Illness Category Impact Survival and Neurologic Outcomes for In-hospital Pediatric Cardiac Arrests

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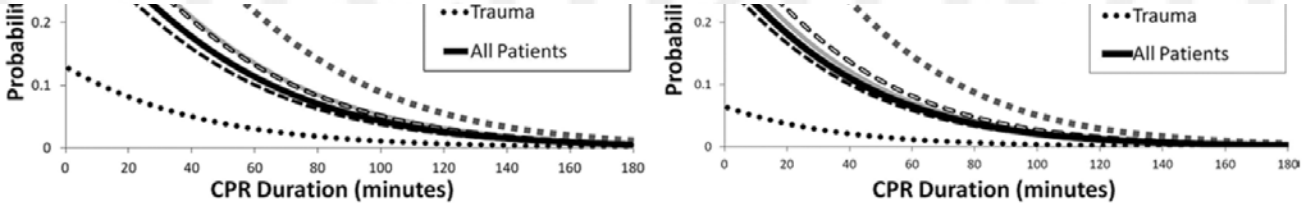
Table 2. Continued

Category of CPR duration, n (%)	General Surgical	Surgical Cardiac	Medical Cardiac	General Medical	Trauma	All Patients
1–15 min	124 (46.3)	272 (38.3)	196 (34.3)	583 (39.5)	211 (54.0)	1386 (40.5)
16–35 min	74 (27.6)	172 (24.2)	196 (34.3)	480 (32.5)	115 (29.4)	1037 (30.3)
>35 min	70 (26.1)	267 (37.6)	180 (31.5)	414 (28.0)	65 (16.6)	996 (29.1)



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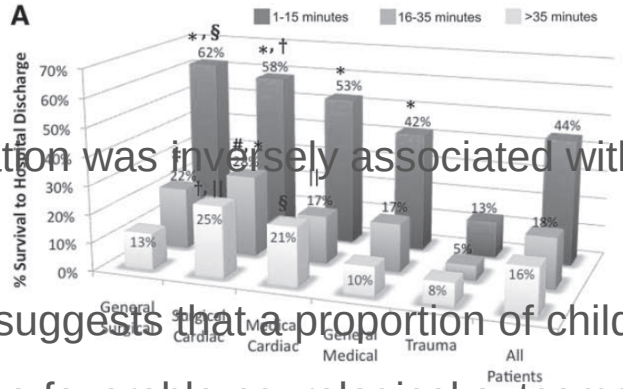
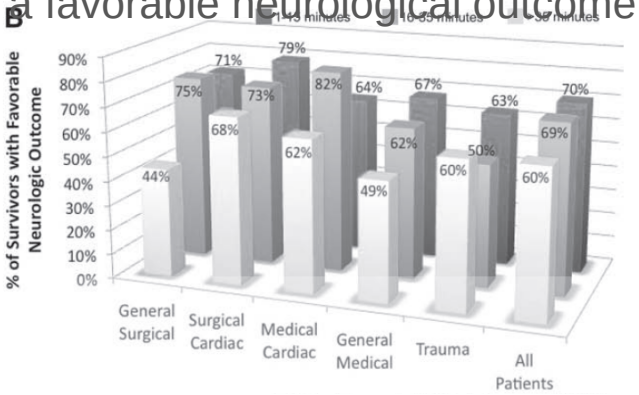
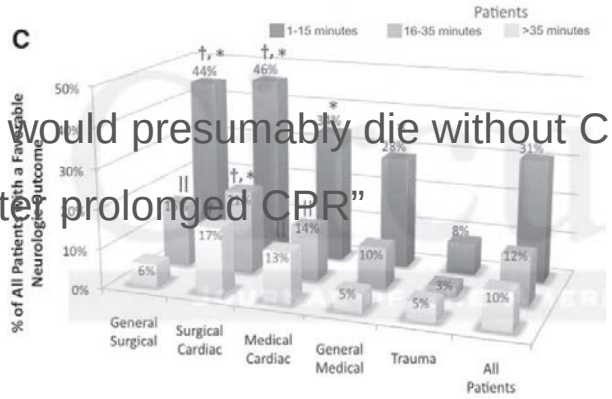






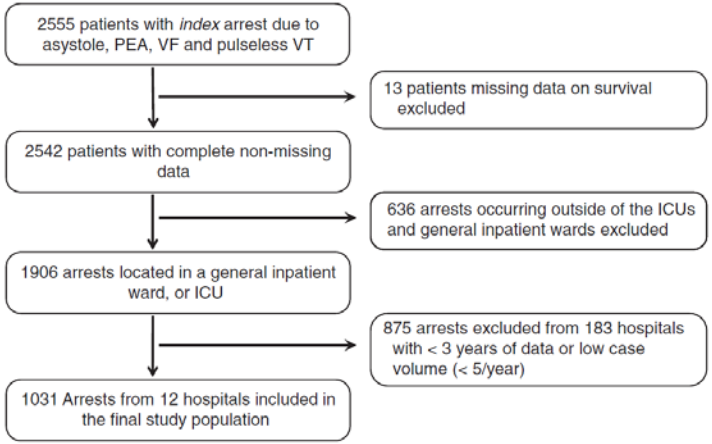
- …CPR duration was inversely associated with survival to hospital discharge and neurological outcome…
- "This study suggests that a proportion of children who would presumably die without CPR survive with a favorable neurological outcome even after prolonged CPR"

Circulation; November 14, 2017, Volume 136, Issue 20

Survival Trends in Pediatric In-Hospital Cardiac Arrests

An Analysis From Get With The Guidelines–Resuscitation

Saket Girotra, MD, SM; John A. Spertus, MD, MPH; Yan Li, PhD; Robert A. Berg, MD; Vinay M. Nadkarni, MD; Paul S. Chan, MD, MSC; for the American Heart Association Get With the Guidelines–Resuscitation Investigators*



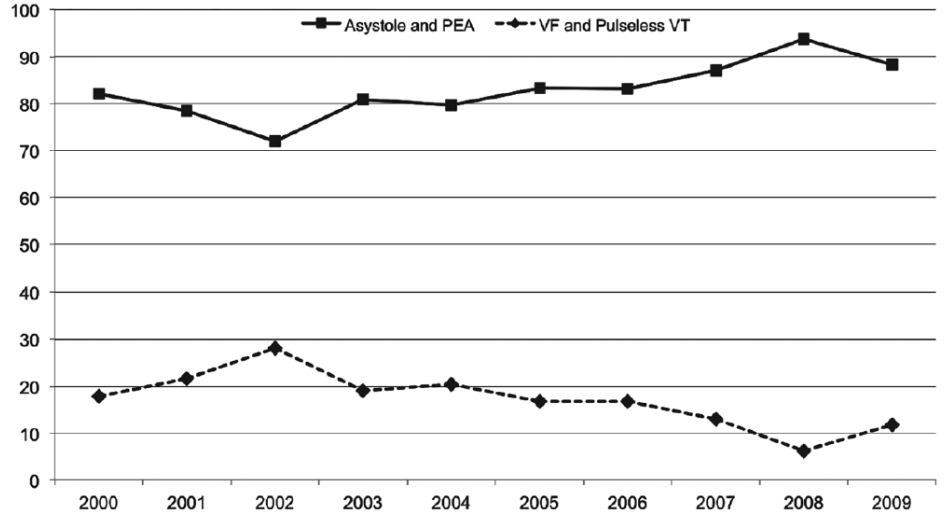


Figure 2. Proportion of cardiac arrests attributable to asystole or pulseless electrical activity (PEA) and ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT) by calendar year. Over the past decade, the proportion of cardiac arrests treatable by defibrillation (VF and pulseless VT) has decreased (*P* for trend <0.001).

Circ Cardiovasc Qual Outcomes.2013;6:42-49

Survival Trends in Pediatric In-Hospital Cardiac Arrests
An Analysis From Get With The Guidelines–Resuscitation

Saket Girotra, MD, SM; John A. Spertus, MD, MPH; Yan Li, PhD; Robert A. Berg, MD; Vinay M. Nadkarni, MD; Paul S. Chan, MD, MSC; for the American Heart Association Get With the Guidelines–Resuscitation Investigators*

Table 2. Observed (Unadjusted) Rates of Survival Outcomes and Neurological Disability by Calendar Year

	2000 (n=28)	2001 (n=37)	2002 (n=64)	2003 (n=89)	2004 (n=98)	2005 (n=149)	2006 (n=125)	2007 (n=154)	2008 (n=193)	2009 (n=94)	*P* for Trend
Survival to discharge, % (n)	14.3 (4)	24.3 (9)	34.4 (22)	30.3 (27)	29.6 (29)	23.5 (35)	44.0 (55)	41.6 (64)	39.9 (77)	39.4 (37)	<0.001
Acute resuscitation survival,* % (n)	42.9 (12)	62.2 (23)	70.3 (45)	55.1 (49)	71.4 (70)	62.4 (93)	77.6 (97)	74.7 (115)	77.7 (150)	77.7 (73)	<0.001
Postresuscitation survival,† % (n)	33.3 (4)	39.1 (9)	48.9 (22)	55.1 (27)	41.4 (29)	37.6 (35)	56.7 (55)	55.7 (64)	51.3 (77)	50.7 (37)	0.04
Significant neurological disability,‡ % (n/survivors)	0 (0/3)	0 (0/8)	12.5 (2/16)	17.4 (4/23)	4.4 (1/23)	12.0 (3/25)	16.0 (8/50)	13.2 (7/53)	9.2 (6/65)	21.9 (7/32)	0.32

Unadjusted rates for survival to discharge, acute resuscitation survival, postresuscitation survival, and significant neurological disability are reported for the overall cohort by calendar year.

*Acute resuscitation survival was determined by the number of patients with return of spontaneous circulation for at least 20 minutes divided by the number of patients with cardiac arrest.

†Postresuscitation survival was determined by the number of patients with acute resuscitation survival who survived to hospital discharge divided by the number surviving the acute resuscitation.

‡Neurological disability in survivors. Neurological disability was defined as the proportion of patients surviving to hospital discharge with a pediatric cerebral performance category (PCPC) score of >3 (ie, at least severe neurological disability). Discharge PCPC scores were missing in 17% of survivors.

Table 4

	ed RR per 95% CI)	*P* for Trend
Survival t	.01–1.16)	0.02
Acute res	.01–1.07)	0.006
Postresus	.98–1.09)	0.17

Circ Cardiovasc Qual Outcomes.2013;6:42-49

Survival Trends in Pediatric In-Hospital Cardiac Arrests
An Analysis From Get With The Guidelines–Resuscitation

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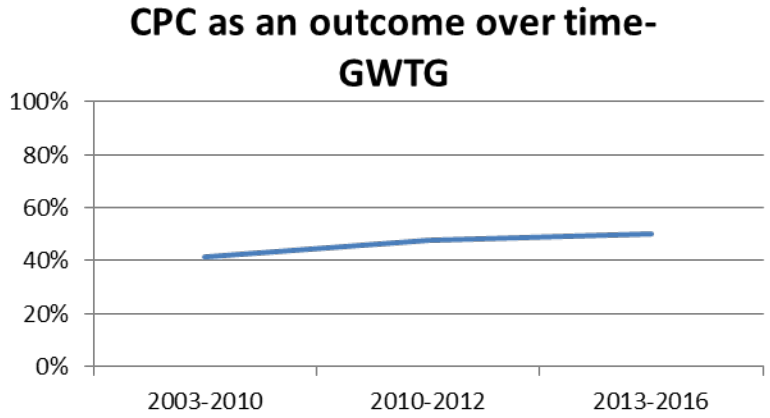
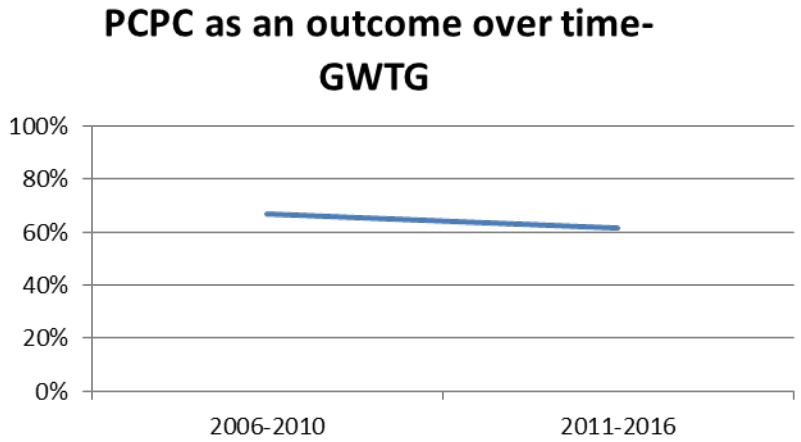
- "In conclusion, we found that overall survival in children with an in-hospital cardiac arrest has improved substantially over the past decade without higher rates of significant neurological disability."

- "Given the smaller sample size and **high rates of missing data (17%)**, we were able to examine only unadjusted trends in rates of neurological disability.
  - Therefore, our findings on this secondary outcome should be interpreted with caution. "

Circ Cardiovasc Qual Outcomes.2013;6:42-49





CPC/PCPC in the literature

- Surrogate for long term survival
- Measure of therapeutic effectiveness
- Prognostic value
  - Pre arrest
  - Post arrest
- Hypothesis generation

- **Changes in practice!**

CPC/PCPC

- Most sites don’t chart this in the medical record
  - **You need to “calculate” it !!**
- It is easy to calculate!
  - **Don’t check undocumented in the GWTG forms because it isn't written in the medical record**
  - **Only score as not documented if there is no information in the chart to help you score it (which would be really, really, really, unusual)**
- Even if there is not data on admit to score the CPC/PCPC, there will be some on discharge
  - **There should always be a discharge CPC/PCPC!**

Thank you!

Any questions?

Contact Us to Learn More

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