WORKSHEET for Evidence-Based Review of Science for Veterinary CPCR

1. Basic Demographics

Worksheet author(s)

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[redacted]	[redacted]

2. Clinical question:

In dogs and cats in cardiac arrest (P), does the use of ECG monitoring during CPCR (I), compared with no ECG monitoring (C), improve outcome (e.g. ROSC, survival to discharge) (O)

3. Conflict of interest specific to this question:

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? No

4. Search strategy (including electronic databases searched):

4a. Databases

PubMed (performed on 12 April 2011)

1. (cardiopulmonary resuscitation OR CPCR or cardiopulmonary cerebral resuscitation) AND ECG Limits: Humans, Animals, Clinical Trial, Meta-Analysis, Randomized Controlled Trial, Review, English, MEDLINE, Veterinary Science 81 hits 8 relevant including 2 review articles
2. (heart arrest[Title/Abstract]) AND (ECG[Title/Abstract]) 8 hits 0 relevent

CAB (performed 14 April 2011)

1. cardiopulmonary resuscitation and ECG).mp. [mp=abstract, title, original title, broad terms, heading words] 9 hits, no additional articles
2. (cardiopulmonary resuscitation and electrocardiogram).mp. [mp=abstract, title, original title, broad terms, heading words] 2 hits, no additional articles

4b. Other sources

-GOOGLE SCHOLAR (performed on 14 April 2011)

1. allintitle: (cardiopulmonary resuscitation OR CPCR OR cardiopulmonary cerebral resuscitation) AND ECG 3 hits, 0 relevant

-References of the following relevant review articles were checked:

1. J Vet Intern Med. 2008 Jan-Feb;22(1):9-25 Plunkett SJ, McMichael M. Cardiopulmonary resuscitation in small animal medicine: an update.

2. Circulation. 2005 Dec 13 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. ECC Committee, Subcommittees and Task Forces of the American Heart Association.Circulation. 2005 Dec 13

3. Circulation. 2010 Nov 2;122(18 Suppl 3):S676-84. Part 4: CPR overview: 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.

4. Cole SG, Otto CM, et al. Cardiopulmonary cerebral resuscitation in small animals – a clinical practice review. Part II J Vet Emerg Crit Care 2003; 13(1):13-23.

5. Boller, M eta l. The clinical practice of CPCR in small animals: an internet-based survey. J Vet Emerg Crit Care 2010; 20(6):558-570.

4c. State inclusion and exclusion criteria for choosing studies and list number of studies excluded per criterion

Inclusion criteria
Clinical trials, review articles (for references), meta-analysis, randomized controlled trials

Exclusion criteria
Abstracts only, non peer reviewed literature

4d. Number of articles/sources meeting criteria for further review:
6 articles met the criteria for review. Of these 4 were LOE 6 and 3 were LOE 4.

Review of these articles led to increasing the search parameters to include studies looking at arrest rhythms and quality of chest compressions. This lead to the inclusion of 6 more articles. Of these all were LOE 6.

5. Summary of evidence

Evidence Supporting Clinical Question

Good						
Fair						*Nadkarni VM 2006 C; Meaney PA 2010 C*
Poor						*Mogayzwl C 1995 C*
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Non-target species studies

Evidence Neutral to Clinical question

Good						*Berg 2001 B&D*
Fair					Hofmeister EH 2009 A;	*Abella 2005 A;* Boller, M 2010 E
Poor						*Herlitz 2008 C; Kajino 2008 D; Olasveengen 2009 C&D*
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Non-target species studies

Evidence Opposing Clinical Question

Good						
Fair						*Hallstrom A 2007 C*
Poor						
	1	**2**	**3**	**4**	**5**	**6**
Level of evidence (P)						

A = Return of spontaneous circulation
B = Survival of event
C = Survival to hospital discharge
D = Intact neurological survival
E = Other endpoint
Italics = Non-target species studies

6. REVIEWER'S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

There are no studies that directly investigate the use of electrocardiogram (ECG) on survival in cardiopulmonary cerebral resuscitation (CPCR) in animals or people. The 2000 American Heart Association CPCR guidelines for pediatric advanced life support recommend the use of ECG monitoring for arrhythmia detection. Subsequent modifications of the guidelines (2005, 2010) do not directly address the use of ECG during CPCR however recommendations are made in regards to treatment of cardiac arrhythmias. It is inferred from the guidelines that ECG monitoring for rhythm analysis is necessary in order to detect and appropriately treat cardiac arrhythmias.

There are multiple studies that demonstrate a better outcome when CPCR is performed in people who present with a first documented arrhythmia of ventricular fibrillation (VF) or ventricular tachycardia (VT) (Nadkarni 2006; Meaney 2010; Mogayzwl 1995). Continuous monitoring of an ECG during CPCR to detect conversion to a shockable rhythm has been studied and the results are mixed. Hallstrom et al showed that people presenting in asystole or pulseless electrical activity (PEA) which converted to VF or VT and were defibrillated had a worse outcome then those who did not convert to VF/VT and were not defibrillated (Hallstrom 2007). Other studies have shown higher survival rates among that population. (Herlitz 2008; Kajino 2008; Olasveengen 2009) Evidence is mixed regarding outcome associated with ECG monitoring during CPCR beyond determination of the presenting rhythm.

Multiple studies have shown worse outcome associated with frequent interruption of chest compressions during CPCR. (Abella 2005; Berg 2001) Minimizing interruption of chest compressions is recommended in the 2010 AHA CPCR guidelines. Although not directly related to the subject matter of the worksheet this needs to be considered as cessation of chest compressions are required for ECG assessment.

7. Conclusion

CONSENSUS ON SCIENCE: Multiple studies have shown that early detection and defibrillation of ventricular fibrillation (VF) as a first documented rhythm in CPCR leads to better outcomes as compared to other arrest rhythms (Mogayzel 1995, Meaney 2010). It is inferred from these studies that ECG monitoring was utilized to detect VF. The distribution of first documented heart rhythms in CPCR in dogs and cats more closely parallels that of children vs. adults (Hofmeister 2009; Nadkarni 2006). Despite a lower incidence of VF in children vs. adults, children with VF as a first documented arrhythmia have better outcomes as compared to children with other first documented arrhythmias, specifically pulseless electrical activity (PEA) and asystole. (Mogayzel 1995; Nadkarni 2006) In these studies most patients with VT or VF were defibrillated. Most patients with PEA or asystole were not defibrillated.

Another group of studies looked at outcome of people whose first documented arrhythmia was PEA or asystole. In one study (Hallstrom 2007) patients found with an initial arrest rhythm of PEA or asystole that subsequently developed VF and were defibrillated had a worse outcome as compared to those patients who did not spontaneously convert to VF. The protocol used in this study group called for stopping compressions every 2 minutes to assess the ECG for VF and defibrillate if necessary. The authors postulate that since in this study the group of patients who subsequently developed VF and were defibrillated had a worse outcome that longer intervals of chest compressions and less interruptions of chest compressions for ECG analysis may be of benefit in patients presenting in PEA/asystole. Other studies showed a better outcome in those patients who converted to VF and were defibrillated. (Herlitz 2008; Kajino 2008; Olasveegen 2009) These studies are difficult to compare as there were significant differences in the patient populations. In one study, which showed a better outcome in the shock group (Kajino 2008), the patient population studied had significantly more positive prognostic indicators as compared a study that showed a worse outcome in the shock group (Hallstrom 2007). There were also differences in the resuscitation protocol between all four studies that may have influenced study results.

TREATMENT RECOMMENDATIONS: Electrocardiogram should be utilized to identify and treat shockable presenting arrhythmias (pulseless ventricular tachycardia and VF) in CPCR. The majority of the veterinary patient population has a presenting arrest rhythm of PEA or asystole (Hofmeister 2009). Continuous ECG monitoring beyond documentation of presenting arrhythmia is of questionable benefit in patients presenting in PEA or asystole (Hallstrom 2007). Continued accurate monitoring of ECG requires interruption of chest compressions. Evidence shows worse outcomes with frequent interruption of chest compressions (Abella 2005; Berg 2001) There is a lack of evidence that continued monitoring of ECG beyond first rhythm identification provides a benefit to patients presenting in PEA or asystole. Monitoring of ECG after first rhythm documentation should be utilized with caution in patients presenting with an initial arrest rhythm of PEA or asystole and weighed against the risk of interrupting chest compressions for ECG analysis. Electrocardiogram should be utilized to document initial arrest rhythm in order to identify the subset of patients who may benefit from defibrillation.

8. Acknowledgement

9. Citation list

Abella BS, Sandbo N et al. Compression rates during cardiopulmonary resuscitation are suboptimal: A prospective study during in-hospital cardiac arrest. Circulation 2005; 111;428-434.

Background—Recent data highlight a vital link between well-performed cardiopulmonary resuscitation (CPR) and survival after cardiac arrest; however, the quality of CPR as actually performed by trained healthcare providers is largely unknown. We sought to measure in-hospital chest compression rates and to determine compliance with published international guidelines.
Methods and Results—We developed and validated a handheld recording device to measure chest compression rate as a surrogate for CPR quality. A prospective observational study of adult cardiac arrests was performed at 3 hospitals from April 2002 to October 2003. Resuscitations were witnessed by trained observers using a customized personal digital assistant programmed to store the exact time of each chest compression, allowing offline calculation of compression rates at serial time points. In 97 arrests, data from 813 minutes during which chest compressions were delivered were analyzed in 30-second time segments. In 36.9% of the total number of segments, compression rates were _80 compressions per minute (cpm), and 21.7% had rates _70 cpm. Higher chest compression rates were significantly correlated with initial return of spontaneous circulation (mean chest compression rates for initial survivors and nonsurvivors, 90_17 and 79_18 cpm, respectively; *P*_0.0033).
Conclusions—In-hospital chest compression rates were below published resuscitation recommendations, and suboptimal compression rates in our study correlated with poor return of spontaneous circulation. CPR quality is likely a critical determinant of survival after cardiac arrest, suggesting the need for routine measurement, monitoring, and feedback systems during actual resuscitation.

LOE 6; neutral

Berg RA, Sanders AB et al. Adverse hemodynamic effects of interrupting chest compressions for rescue breathing during cardiopulmonary resuscitation for ventrical fibrillation cardiac arrest. Circulation 2001; 104:2465-70.

Background—Despite improving arterial oxygen saturation and pH, bystander cardiopulmonary resuscitation (CPR) with chest compressions plus rescue breathing (CC_RB) has not improved survival from ventricular fibrillation (VF) compared with chest compressions alone (CC) in numerous animal models and 2 clinical investigations.
Methods and Results—After 3 minutes of untreated VF, 14 swine (32_1 kg) were randomly assigned to receive CC_RB or CC for 12 minutes, followed by advanced cardiac life support. All 14 animals survived 24 hours, 13 with good

neurological outcome. For the CC_RB group, the aortic relaxation pressures routinely decreased during the 2 rescue breaths. Therefore, the mean coronary perfusion pressure of the first 2 compressions in each compression cycle was lower than those of the final 2 compressions (14_1 versus 21_2 mm Hg, *P*_0.001). During each minute of CPR, the number of chest compressions was also lower in the CC_RB group (62_1 versus 92_1 compressions, *P*_0.001). Consequently, the integrated coronary perfusion pressure was lower with CC_RB during each minute of CPR (*P*_0.05 for the first 8 minutes). Moreover, at 2 to 5 minutes of CPR, the median left ventricular blood flow by fluorescent microsphere technique was 60 mL · 100 g_1 · min_1 with CC_RB versus 96 mL · 100 g_1 · min_1 with CC, *P*_0.05. Because the arterial oxygen saturation was higher with CC_RB, the left ventricular myocardial oxygen delivery did not differ.
Conclusions—Interrupting chest compressions for rescue breathing can adversely affect hemodynamics during CPR for VF.

LOE 6; neutral

Boller M, Kellett-Gregory L et al. The clinical practice of CPCR in small animals: an internet-based survey. J Vet Emerg Crit Care 2010; 20(6) 558-570.

Objective – To characterize the provision of CPCR by small animal veterinarians in clinical practice and to assess how this practice varies among different levels of expertise.
Design – Internet-based survey.
Setting – Academia, referral practice, and general practice.
Subjects – Six hundred and two small animal veterinarians in clinical practice. Respondents were grouped a priori according to level of expertise: board-certified (ACVECC, ACVA, ECVAA) specialists; general practitioners in emergency clinics; general practitioners in general practice (GPG).
Interventions – Email invitations to the online questionnaire were disseminated via a veterinary internet platform and mailing list server discussion groups. Questions explored respondent characteristics, CPCR preparedness, infrastructural and personnel resources, and techniques of basic and advanced life support.
Main Results – In this group of practitioners, the majority (65%) were in general practice. GPG were more likely to perform CPCR o5 times per year and to have 3 or fewer members on their resuscitation team. Most practitioners have a crash cart and drug-dosing chart available. GPG were less likely to obtain resuscitation codes on their patients, and less likely to use end-tidal carbon dioxide monitoring or defibrillation. Intubation, oxygen supplementation, vascular access, and external thoracic compressions were widely used, however, GPG were more likely to use lower chest compression rates. Drugs used for CPCR differed among the groups with GPG more likely to use doxapram and glucocorticoids.
Conclusions – CPCR is heterogeneously performed in small animal veterinary medicine; differences exist, both among and within different types of veterinarians with varying levels of expertise, in respect to available infrastructure, personnel and CPCR techniques used.

Level 6; neutral
Internet based survey, target species. Among veterinarians surveyed ECG monitoring during CPCR varied according to type of practice (board certified specialists 100%, general practitioners 60.5%, general emergency practitioners 84.4%) Level of importance of ECG monitoring during CPCR (scale of 1-10, 10 being absolutely necessary) was reported as 9.5 for board certified specialists, 9.3 for general emergency practitioners and 7.9 for general practitioners. ECG monitoring was available in most hospitals (board certified specialists 100%, general emergency practitioners 97.4% and general practitioners 83.1%).

Hallstrom A, Rea TD et al. The relationship between shocks and survival in out-of-hospital cardiac arrest patients initially found in PEA or asystole. Resuscitation 2007; 74:418-26.

Summary
Objective: To describe survival rates from out-of-hospital cardiac arrest for patients who present with pulseless electrical activity or asystole according to whether they remained in a non-shockable rhythm or converted to ventricular fibrillation and were shocked appropriately.
Methods:
Design: Observational analysis of a cardiac arrest registry collected as part of a randomized trial.
Setting: Five urban/suburban cities in the United States and Canada.
Participants: Trial subjects (adult, treated, non-traumatic) whose first documented heart rhythm/state following cardiac arrest was asystole or pulseless electrical

activity.
Intervention: Periodic pauses to assess for shockable rhythm.
Main outcome measure: Survival to hospital discharge.

Level 6; opposing

Herlitz J, Svensson L et al. Characteristics and outcome in out-of-hospital cardiac arrest when patients are found in a non-shockable rhythm. Resuscitation 2—8: 76:31-36.

Summary
Aim: To define factors associated with an improved outcome among patients suffering out-ofhospital cardiac arrest (OHCA) who were found in a non-shockable rhythm.
Patients: All the patients included in the Swedish OHCA registry between 1990 and 2005 in whom resuscitation was attempted, who were found in a non-shockable rhythm and where either the OHCA was witnessed by a bystander or was not witnessed.
Results: In all, 22,465 patients fulfilled the inclusion criteria. Their mean age was 67 years, 32% were women, 57% were witnessed, 64% had a cardiac aetiology, 71% occurred at home and 34% received bystander cardiopulmonary resuscitation (CPR). Survival to 1 month was 1.3%. The following were independently associated with an increased chance of survival: 1/Decreasing age, 2/Witnessed arrest, 3/Bystander CPR, 4/Cardiac arrest outside home, 5/Shorter ambulance response time and 6/Need for defibrillatory shock.
If these six criteria were fulfilled (age and ambulance response time below the median), survival to 1 month increased to 12.6%. If no criteria were fulfilled, survival was 0.15%.
Conclusion: The overall survival among patients with an OHCA found in a non-shockable rhythm is very low (1.3%). Six factors associated with survival can be defined. When they are taken into account, survival varies between 12.6 and 0.15%.

Level 6; supportive

Hofmeister EH, Brainard BM et al. Prognostic indicators for dogs and cats with cardiopulmonary arrest treated by cardiopulmonary cerebral resuscitation at a university teaching hospital. J Am Vet Med Assoc 2009; 235(1):50-57.

OBJECTIVE:
To determine the association among signalment, health status, other clinical variables, and treatments and events during cardiopulmonary cerebral resuscitation (CPCR) with the return of spontaneous circulation (ROSC) for animals with cardiopulmonary arrest (CPA) in a veterinary teaching hospital.

DESIGN:
Cross-sectional study.

ANIMALS:
161 dogs and 43 cats with CPA.

PROCEDURES:
Data were gathered during a 60-month period on animals that had CPA and underwent CPCR. Logistic regression was used to evaluate effects of multiple predictors for ROSC.

RESULTS:
56 (35%) dogs and 19 (44%) cats had successful CPCR. Twelve (6%) animals (9 dogs and 3 cats) were discharged from the hospital. Successfully resuscitated dogs were significantly more likely to have been treated with mannitol, lidocaine, fluids, dopamine, corticosteroids, or vasopressin; had CPA while anesthetized; received chest compressions while positioned in lateral recumbency; and had a suspected cause of CPA other than hemorrhage or anemia, shock, hypoxemia, multiple organ dysfunction syndrome, cerebral trauma, malignant arrhythmia, or an anaphylactoid reaction and were less likely to have been treated with multiple doses of epinephrine, had a longer duration of CPA, or had multiple disease conditions, compared with findings in dogs that were not successfully resuscitated. Successfully resuscitated cats were significantly more likely to have had more people participate in CPCR and less likely to have had shock as the suspected cause of CPA, compared with findings in cats that were not successfully resuscitated.

CONCLUSIONS AND CLINICAL RELEVANCE:
The prognosis was grave for animals with CPA, except for those that had CPA while anesthetized.

Level 5; neutral

Kajino K, Iwami T et al. Subsequent ventricular fibrillation and survival in out-of-hospital cardiac arrests presenting with PEA or asystole. Resuscitation 2008;79:34-40.

Summary
Background: The prognostic implications of conversion to ventricular fibrillation (VF) in out-ofhospital cardiac arrest (OHCA) patients with an initial non-shockable rhythm are unclear.
Hypothesis: Among OHCA patients with an initial non-shockable rhythm, survival is better in individuals who subsequently develop VF and are defibrillated.
Methods: Design: Utstein style population-based cohort study. Subjects: adults (age_18 years) with OHCA of presumed cardiac etiology and initial rhythm of pulseless electrical activity (PEA) or asystole treated by emergency medical services systems in Osaka, Japan from January 1, 2001 to December 31, 2005. Primary outcome measure was one-month neurologically favorable survival (CPC$\leq$2). Outcome of patients with subsequent VF (SHOCK group) was compared to that of patients with sustained non-shockable rhythm (NON-SHOCK group) using logistic regression to adjust for potential confounding variables.
Results: Of 14,316 OHCA, 12,353 cases had PEA or asystole as the initial rhythm. Of these, 11,766 (95%) remained in a non-shockable rhythm throughout the resuscitation effort while 587 (5%) subsequently developed VF and were defibrillated. Neurologically favorable survival at one month was significantly better in the SHOCK group (6% versus 1%, $p < 0.001$). Subsequent VF remained a significant predictor (OR, 4.3; 95% CI, 2.8—6.7) of neurologically favorable survival after adjustment for potential confounders.
Conclusions: Based on a large-scaled population-based cohort of OHCA, subsequent VF with defibrillation was associated with better outcomes among patients with an initial non-shockable rhythm.

Level 6; supportive

Magoyzel C, Quan L et al. Out-of-hospital ventricular fibrillation in children and adolescents: Causes and Outcomes. Ann Emerg Med 1995; 25:4 484-491.

Study objective: To compare causes and outcomes of patients younger than 20 years with an initial rhythm of ventricular fibrillation versus asystole and pulseless electrical activity.
Design: Retrospective cohort study.
Setting: Urban/suburban prehospital system.
Participants: Pulseless, nonbreathing patients less than 20 years who underwent out-of-hospital resuscitation. Patients with lividity or rigor mortis or who were less than 6 months old and died of sudden infant death syndrome were excluded.
Results: Ventricular fibrillation was the initial rhythm in 19% (29 of 157) of the cardiac arrests. Rhythm assessment was performed by the first responder in only 44% (69 of 157) of patients. All three rhythm groups were similar in age distribution, frequency of intubation (96%), and vascular access (92%); 93% of ventricular fibrillation patients were defibrillated. The causes of ventricular fibrillation were distributed evenly among medical illnesses, overdoses, drownings, and trauma; only two patients had congenital heart defects. Seventeen percent were discharged with no or mild disability, compared with 2% of asystole/pulseless electrical activity patients (P=.003).
Conclusion: Ventricular fibrillation is not rare in child and adolescent prehospital cardiac arrest, and these patients have a better outcome than those with asystole or pulseless electrical activity. Earlier recognition and treatment of ventricular fibrillation

might improve pediatric cardiac arrest survival rates.

Level 6; supportive
Retrospective cohort human study. All pediatric VF survivors with a good outcome had early recognition of their dysrhythmia and early defibrillation. The authors suggest that early detection of VF and appropriate treatement (defibrillation) could improve pediatric survival rates. The study also documented progression of cardiac arrythmias over time leading to asystole. At the time of this study the AHA prohibited the use of automatic external defibrillators on pediatric patients. The authors hypothesized that because of these guidelines children often don't receive early rhythm identification and early defibrillation. Because of the lag in rhythm identification in children and the progression of dysrhythmias over time, the true prevalence of VF may be greater than reported. The authors recommend early rhythm identification in order to detect and treat VF and thus improve pediatric survival rates.

Meaney PA, Nadkarni VM et al. Rhythms and outcomes of adult in-hospital cardiac arrest. Crit Care Med 2010 38(1) 101-108.

Objective: To determine the relationship of electrocardiographic rhythm during cardiac arrest with survival outcomes.
Design: Prospective, observational study.
Setting: Total of 411 hospitals in the National Registry of Cardiopulmonary Resuscitation.
Patients: Total of 51,919 adult patients with pulseless cardiac arrests from April 1999 to July 2005.
Measurements and Main Results: Registry data collected included first documented rhythm, patient demographics, pre-event data, event data, and survival and neurologic outcome data. Of 51,919 indexed cardiac arrests, first documented pulseless rhythm was ventricular tachycardia (VT) in 3810 (7%), ventricular fibrillation (VF) in 8718 (17%), pulseless electrical activity (PEA) in 19,262 (37%) and asystole 20,129 (39%). Subsequent VT/VF (that is, VT or VF occurring during resuscitation for PEA or asystole) occurred in 5154 (27%), with first documented rhythm of PEA and 4988 (25%) with asystole. Survival to hospital discharge rate was not different between those with first documented VF and VT (37% each, adjusted odds ratio _OR_) 1.08; 95% confidence interval _CI_0.95–1.23). Survival to hospital discharge was slightly more likely after PEA than asystole (12% vs. 11%, adjusted OR 1.1; 95% CI 1.00 –1.18), Survival to discharge was substantially more likely after first documented VT/VF than PEA/asystole (adjusted OR 1.68; 95% CI 1.55–1.82). Survival to discharge was also more likely after PEA/asystole without subsequent VT/VF compared with PEA/ asystole with subsequent VT/VF (14% vs. 7% for PEA without vs. with subsequent VT/VF; 12% vs. 8% for asystole without vs. with subsequent VT/VF; adjusted OR 1.60; 95% CI, 1.44 –1.80).
Conclusions: Survival to hospital discharge was substantially more likely when the first documented rhythm was shockable rather than nonshockable, and slightly more likely after PEA than asystole. Survival to hospital discharge was less likely following PEA/asystole with subsequent VT/VF compared to PEA/asystole without subsequent VT/VF.

Level 6; supportive
Prospective observational multicentered human study. Compared survival in adults with in hospital cardiac arrest in regards to first documented rhythm. Adults with a first documented rhythm of pulseless ventricular tachycardia or ventricular fibrillation were significantly more likely to survive to hospital discharge as compared to adults with a first document rhythm of pulseless electrical activity or asystole. Adults with PEA/asystole who subsequently developed VT/VF had a worse prognosis then those adults with PEA/asystole who did not develop VT/VF. First documented rhythms were assessed using ECG.

Nadkarni VM, Larkin GL et al. First documented rhythm and clinical outcome from in-hospital cardiac arrest among children and adults. JAMA 295(1); 50-57.

Context Cardiac arrests in adults are often due to ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), which are associated with better outcomes than asystole or pulseless electrical activity (PEA). Cardiac arrests in children are typically asystole or PEA.
Objective To test the hypothesis that children have relatively fewer in-hospital cardiac arrests associated with VF or pulseless VT compared with adults and, therefore, worse survival outcomes.
Design, Setting, and Patients A prospective observational study from a multicenter registry (National Registry of Cardiopulmonary Resuscitation) of cardiac arrests in 253 US and Canadian hospitals between January 1, 2000, and March 30, 2004. A total of 36 902 adults (_18 years) and 880 children (_18 years) with pulseless cardiac arrests requiring chest compressions, defibrillation, or both were assessed. Cardiac arrests occurring in the delivery department, neonatal intensive care unit, and in the out-of-hospital setting were excluded.
Main Outcome Measure Survival to hospital discharge.
Results The rate of survival to hospital discharge following pulseless cardiac arrest was higher in children than adults (27% [236/880] vs 18% [6485/36 902]; adjusted odds ratio [OR], 2.29; 95% confidence interval [CI], 1.95-2.68). Of these survivors, 65% (154/236) of children and 73% (4737/6485) of adults had good neurological outcome. The prevalence of VF or pulseless VT as the first documented pulseless rhythm was 14% (120/880) in children and 23% (8361/36 902) in adults (OR, 0.54; 95% CI, 0.44-0.65; *P*_.001). The prevalence of asystole was 40% (350) in children and 35% (13 024) in adults (OR, 1.20; 95% CI, 1.10-1.40; *P*=.006), whereas the prevalence of PEA was 24% (213) in children and 32% (11 963) in adults (OR, 0.67; 95% CI, 0.57-0.78; *P*_.001). After adjustment for differences in preexisting conditions, interventions in place at time of arrest, witnessed and/or monitored status, time to defibrillation of VF or pulseless VT, intensive care unit location of arrest, and duration of cardiopulmonary resuscitation, only first documented pulseless arrest rhythm remained significantly associated with differential survival to discharge (24% [135/563] in children vs 11% [2719/24 987] in adults with asystole and PEA; adjusted OR, 2.73; 95% CI, 2.23-3.32).
Conclusions In this multicenter registry of in-hospital cardiac arrest, the first documented pulseless arrest rhythm was typically asystole or PEA in both children and adults. Because of better survival after asystole and PEA, children had better outcomes than adults despite fewer cardiac arrests due to VF or pulseless VT.

Level 6; supportive
Prospective observational multicentered human study. Compared survival among adults and children with cardiac arrest. Outcome was survival to hospital discharge and was organized by first documented arrest rhythm (Pulseless ventricular tachycardia, ventricular fibrillation, pulseless electrical activity and asystole). Overall PEA and asystole were the most common first rhythm in both adults and children.
Adults had more first document VF and VT than children. Children survived to hospital discharge more frequently than adults when first documented rhythm was PEA or asystole. Shockable rhythms (VF, VT) were more prevalent in children than previous studies. Presenting rhythms were assessed using ECG.

Olasveegen TM, Samdal M et al. Progressing from initial non-shockable rhythms to a shockable rhythm is associated with improved outcome after out-of-hospital cardiac arrest. Resuscitation 2009; 80:24-29.

Background: Cardiac arrest patients with initial non-shockable rhythm progressing to shockable rhythm have been reported to have inferior outcome to those remaining non-shockable.Wewanted to confirm this observation in our prospectively collected database, and assess whether differences in cardiopulmonary resuscitation (CPR) quality could help to explain any such difference in outcome.
Materials and methods: All out-of-hospital cardiac arrest (OHCA) cases in the Oslo EMS between May

2003 and April 2008 were retrospectively studied, and cases with initial asystole or pulseless electrical activity (PEA) were selected. Pre-hospital and hospital records, Utstein forms, and continuous ECGs were reviewed. Quality of CPR and outcomewere compared for patients who progressed to a shockable rhythm and patients who remained in non-shockable rhythms.
Results: Of 753 cases with initial non-shockable rhythms 517 (69%) had asystole and 236 (31%) PEA. Ninetyeight (13%) patients progressed to a shockable rhythm, while 653 (87%) remained non-shockable during the entire resuscitation effort (two unknown). Hands-off ratio was higher in the shockable than the nonshockable group, 0.21°æ0.12 vs. 0.16°æ0.10 ($p = 0.000$) with no significant difference in compression and ventilation rates. Overall survival to hospital discharge was 3%; 7% in the shockable and 2% in the nonshockable group ($p = 0.014$). Based on a multivariate logistic analysis young age, initial PEA, and progressing to a shockable rhythm were associated with better outcome.
Conclusion: Progressing from initial non-shockable rhythms to a shockable rhythm was associated with improved outcome after OHCA. This occurred despite more pauses in chest compressions in the shockable group, probably related to defibrillation attempts.

Level 6; supportive