WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

Worksheet author(s)

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Clinical question.

For adult patients in any setting (P), is there a clinical decision rule (I), that enables reliable prediction of ROSC (or futile resuscitation efforts)?

Is this question addressing an intervention/therapy, prognosis or diagnosis? Prognosis
State if this is a proposed new topic or revision of existing worksheet: New

Conflict of interest specific to this question

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

Search strategy (including electronic databases searched).

Medline – "resuscitation", "in hospital", "survival", "cpr", "cardiac arrest", "cardiopulmonary arrest", "factors influencing survival", "factors" as text words were searched individually, then all possible combinations of these words were searched for. Combinations were collated to 530 total papers. Sorted to 250, duplicates deleted – 73 papers

CINAHL – "resuscitation", "in hospital", "survival", "cpr", "cardiac arrest", "cardiopulmonary arrest", "factors influencing survival", "factors" as text words were searched individually, then all possible combinations of these words were searched for. Combinations were collated to 308 total papers. Sorted to 168, duplicates deleted – 6 papers

Cochrane - "resuscitation", "in hospital", "survival", "cpr", "cardiac arrest", "cardiopulmonary arrest", "factors influencing survival", "factors" as text words were searched individually, then all possible combinations of these words were searched for. Combinations were collated to 28 total papers. Sorted to 2, duplicates deleted – 1 paper which was deleted after reading the abstract.

AHA Endnote - "resuscitation", "in hospital", "survival", "cpr", "cardiac arrest", "cardiopulmonary arrest", "factors influencing survival", "factors" as text words were searched individually, then all possible combinations of these words were searched for. Combinations were collated to 871 total papers. Sorted to 111, resorted to 15, duplicates deleted – 2 papers.

81 total – 2 papers not available in Australia, 2 papers not available in English (77 total). Three discarded after reading – not relevant. (74 total)

Search conducted in September 2007. Search repeated August 2008 (with clinical decision rule) - Four extra papers added to the list (78 total).

After feedback In January 2009
New search completed – Medline and Endnote and Embase.

Medline
1. "Clinical decision rule" = 129
2. "Prediction" = 71730
3. "Return of Spontaneous Circulation" = 585

1 and 2 = 18 – Nil relevant
1 and 3 = 1 – added to list
2 and 3 = 18 – 17 added to list
Total of 18 added (3 were duplicates) therefore 15 new references

Embase
1. "Clinical decision rule" = 137
2. "Prediction" = 170783
3. "Return of Spontaneous Circulation" = 582

1 and 2 = 41 – Nil relevant
1 and 3 = 1 – added to list
2 and 3 = 44 – 30 added to list
Total of 31 added (17 were duplicates) therefore 14 new references

Endnote
Similar search strategy as above – 1 new reference found

Therefore 108 papers in total.

• State inclusion and exclusion criteria

Inclusion criteria
 Resuscitation, in hospital, survival, CPR, cardiac arrest (associated with factors influencing survival), clinical decision rule + prediction + return of
   spontaneous circulation
Exclusion criteria
 Resuscitation, in hospital, survival, CPR, cardiac arrest (not associated with factors influencing survival), clinical decision rule + prediction without
   mention of cardiac arrest, CPR, ROSC.
 Non English papers – 2
 Non available papers – 2

Note – All papers graded and more exclusions added as papers are omitted due to poor content and relevance.

• Number of articles/sources meeting criteria for further review:

108.

Abstracts read and further exclusions due to relevance and content

61 papers for review.

Post reading papers a further 40 articles excluded due to content, relevance and age of the papers.

21 papers for review.

Still awaiting arrival of 6 papers

15 papers reviewed currently 15 February 2009

Feedback from worksheet reviewer 23 February 2009 – remove the papers that look at the factors that influence outcome and concentrate on those that purely relate to the use of a clinical decision rule.

15 papers further excluded. 12 of these references have been left at the end of the worksheet as additional references.

6 papers for review, 1 more paper found during this time. Total 7 papers for review.

June 2009 update – Four more papers sourced
Total 11 papers for review. One paper is a position paper and is included in the discussion for interest and one paper is a review of a number of the studies that are included in this worksheet. It is also included for interest, therefore there are 9 studies in the table.

Summary of evidence

Evidence Supporting Clinical Question

Good	Morrision (2006)[E4 5 6] Morrison (2009)[E4 5 6] Van Walraven (2001)[E9 10 11] Ong (2006)[E4 5 6] Richmond (2008)[E4 5 6]	McCullough (1998)[E1 2 3] Morrison (2007)[E4 5 6 7 8] Van Walraven (1999)[E9 10 11]			
Fair					
Poor					
	P1	**P2**	**P3**	**P4**	**P5**
	Level of evidence				

E1 = BP >90mgHg   E2 = Time to ROSC <25min   E3 = Neuro assessment   E4 = No ROSC   E5 = No shocks
E6 = Not witnessed by EMS   E7 = Not witnessed by bystander   E8 = No Bystander CPR   E9 = Not aWitnessed arrest
E10 = Not VT/VF   E11 = No Pulse within first 10 mins/arrest lasting longer than 10 mins

Evidence Neutral to Clinical question

Good	Bowker (1999)[E12]				
Fair					
Poor					
	P1	**P2**	**P3**	**P4**	**P5**
	Level of evidence				

E12 = Morbidity Scores

Evidence Opposing Clinical Question

Good					
Fair					
Poor					
	P1	**P2**	**P3**	**P4**	**P5**
	Level of evidence				

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

The early 1990's saw development and modification of morbidity scores. George (1989), Ebell (1992) and Dautzenberg (1993) developed Pre-arrest morbidity score (PAM), Prognosis after resuscitation score (PAR) and Modified PAM Index (MPI) respectively. These scores when used individually were found by Bowker (1999) to have too low a sensitivity for predicting unsuccessful CPR to be used alone in practice (PAM 20%, PAR 29%, and MPI 22%). Bowker (1999) used all scores in combination and increased the sensitivity of predicting unsuccessful CPR to 42%. This improvement however is still a low sensitivity to be the only tool to guide clinical practice. Furthermore the combination tool was very unwieldy and from a practical point of view difficult to administer in the field. The three scores utilised a grading system of the patient's morbidity score. All three were able to forecast that those patients with a high morbidity score would not survive to hospital discharge (high specificity) but could not forecast that those who scored a low morbidity score would survive to hospital discharge (low sensitivity). This was due to the scores not taking into account the other factors that influence or predict survival from cardiopulmonary resuscitation. These factors were studied by many of the papers reviewed. Most of these papers have been placed as additional references as they describe predictors of survival rather than the application of a clinical decision tool to predict survival or futility of a resuscitation effort. The discussion about these factors has been deleted from this worksheet.

McCullough (1998) validated a clinical decision rule that applied to cardiac arrest patients to guide prediction of ROSC or futility in the out of hospital group. This rule was applied in the Emergency Department using initial blood pressure, time of ROSC and an initial neurological assessment. Validation or level of agreement when testing this tool across two groups was high for both outcomes of survival or death.

In 2000 the National Association of EMS Physicians published a position paper regarding Termination of Resuscitation in the Prehospital Setting for Adult Patients Suffering Nontraumatic Cardiac Arrest. They reviewed pre 2000 literature and then described an 11 step process for termination of resuscitation. This paper has been included in the citation list for completeness.

Morrison (2006) tested a clinical decision rule for emergency medical technicians (EMTs) trained in the use of an AED. The decision rule (no ROSC, no shocks administered and arrest not witnessed by emergency services personnel) was used to determine cessation of resuscitation efforts. Conversely not meeting the tool guided continuation of resuscitation efforts. The rule had a positive predictive value for death of 99.5%. Morrison (2007) tested a similar but expanded clinical decision tool for advanced life support providers. This clinical decision rule was used to predict death rather than survival with a 100% negative predictive value (95% CI). The decision rule consisted of no ROSC prior to transport, no shock delivered, no bystander CPR and the arrest was not witnessed by bystanders or EMS. Morrison (2009) supported the above studies by validating the clinical decision rule for out of hospital arrests for both advanced and basic life support providers.

The rule validated was no ROSC prior to transport, no shock given and the arrest was not witnessed by EMS. The study had a high specificity and a positive predictive value of 99.8 – 100 (95%CI). The sensitivity was low however which limits the rule to the termination of resuscitation rather than the identification of survivors. However as stated above if the clinical decision rule was not met then continuation of resuscitation efforts was expected. A supportive independent validation of Morrison's Termination of Resuscitation Decision Rule was undertaken by Richmond (2008). Of all those who met the criteria for termination (1,160 patients) only one survived to hospital discharge. The difficulty in putting this rule into practice is how to apply the first part of the rule which is: no ROSC prior to transport. This is easily identified retrospectively but on face value may be difficult to be applied prospectively. Morrison (2006) states that the BLS with Defibrillator algorithm was fully completed prior to any transport (or the patient regained ROSC). On review the complete algorithm consisted of; cardiopulmonary resuscitation, with pauses every one or two minutes to assess rhythm with an automated external defibrillator and to deliver a shock as dictated by the automated analysis of the defibrillator. The rhythm was analyzed no more than three times, with the delivery of no more than three shocks at each analysis, as indicated. On either successful defibrillation or completion of this algorithm, the patient was rapidly transported to the hospital and cardiopulmonary resuscitation was continued, if necessary.

Ong (2006) compared three clinical decision rules in out of hospital arrests. The clinical decision rules were by Petrie (2001), Verbeek (2002) and Marsden (1995). The rules were applied to a prospective cohort of out of hospital arrests numbering 13,684. The Predictive Value for death was 100% (Petrie), 99.9% (Verbeek) and 100% (Marsden). All three of these clinical decision rules were for BLS providers who were trained in defibrillation. Petrie (2001) rule was that resuscitation could be terminated in the field if the initial arrest rhythm was asystole and the call response interval was greater than 8 minutes. Verbeek (2002) rule was that termination could occur if there was no return of spontaneous circulation and no shock was given and the arrest was not witnessed by EMS personnel, Marsden (1995) had a more complex rule – There was not initial shockable rhythm and there was no evidence of CPR in the past 15 minutes and there was not evidence of drowning, hypothermia, poisoning or overdose, the patient was not a child or pregnant and there was no return of spontaneous circulation or a shockable rhythm after 1 minute of CPR and there is asystole for 10 seconds. Of all those who met the criteria for termination, Petrie with 1293 patients had 1 survivor, Verbeek with 6908 patients had 3 survivors and Marsden with 2536 patients had 1 survivor.

Ong (2006) states that Marsden's rule would be difficult to apply in practice due to the fact it is difficult to gauge whether CPR had been given in the past 15 minutes and Petrie's rule where the call response time is greater than 8 minutes as timings are often difficult and not synchronized, therefore Ong's review of the Verbeek clinical decision rule was the only one that has been included in the supportive table and consensus on science statements.

Two papers regarding a clinical decision tool for in hospital patients were found, both by van Walraven (1999 and 2001. van Walraven (1999) derived a clinical decision rule from cardiac arrest outcome data of 1077 patients. The clinical rule predicted no chance for survival from hospital discharge if the cardiac arrest lasted 10 minutes or more after cardiopulmonary resuscitation was started and the initial cardiac rhythm was not ventricular tachycardia or fibrillation and the arrest was not witnessed. The sensitivity was 100% (95% CI, 97.5% - 100%)

van Walraven (2001) then validated this clinical decision tool. The tool predicted survival to discharge for those patients who had a witnessed arrest, VT/VF, or a pulse within the first 10min of chest compressions. There were 327 resuscitations for which patients were discharged from hospital, all but 3 satisfied the decision aid, resulting in a sensitivity of 99.1% (95% CI).

The question of which CPR guidelines were used in each of the papers also needs to be addressed. If a decision rule was derived using CPR guidelines 2000 then would the rule still be valid for CPR guidelines 2005. The table below outlines the studies and which CPR guidelines were used at the time.

McCullough 1998	Study period from 1989 – 1996 – therefore 5:1 CPR ratio used
Van Walraven 1999	Study period from 1989 – 1995 – therefore 5:1 CPR ratio used
Van Walraven 2001	Study period from 1987 – 1996 – therefore 5:1 CPR ratio used
Morrison 2006	Study period from 2002 – 2004 – therefore 15:2 CPR ratio used
Ong 2006	Study period from 1998 – 2003 – therefore potentially 5:1 and 15:2 CPR ratio's could have been used
Morrison 2007	Study period from 1998 – 2003 – therefore potentially 5:1 and 15:2 CPR ratio's could have been used
Richmond 2008	Study period from 2004 – 2006 – therefore potentially 15:2 and 30:2 CPR ratio's could have been used
Morrison 2009	Study period from 2006 – 2007 – therefore 30:2 CPR ratio used

However the reproducibility (from derivation to validation of same tools) adds strength to the argument that the tools are strong enough to withstand changes in resuscitation guidelines over time.

Interpreting the literature is difficult when some studies van Walraven (2001; Morrison (2007) and Ong (2006) predict survival, whilst Richmond (2008); Morrison (2006) and Morrison (2009) predict death. This makes comparisons difficult and confusing.

Morrison (2008) has published a guide to interpreting the literature regarding clinical decision rules. This guide highlights this difficulty of science interpretation when some papers use a rule that was derived using survival and some papers use a rule that was derived using death. The table below outlines the studies which Morrison identified plus additional studies referred to in this worksheet. The predictive value is for death.

Out of hospital studies	Prediction to die	Survival	Predictive Value
BLS Morrison 2006	776	4	99.5%
ALS Morrison 2007	1425	0	100%
BLS Morrison 2007	2263	0	100%
ALS Morrison 2009	743	0	100%
BLS Morrison 2009	1302	0	100%
BLS Richmond 2008	1160	1	99.9%
BLS Ong (Petrie) 2006	1293	1	99.9%
BLS Ong (Verbeek) 2006	6908	3	100%
BLS Ong (Marsden) 2006	2536	1	100%
In hospital studies			
Van Walraven 2001	269	3	98.9%
Van Walraven 1999	119	0	100%

As described all these clinical decision tools can accurately predict **no** chance of survival but are only able to predict **some** chance of survival.

Acknowledgements:

Nil

Citation List

Bailey, E. D., G. C. Wydro, et al. (2000). "Termination of resuscitation in the prehospital setting for adult patients suffering nontraumatic cardiac arrest. National Association of EMS Physicians Standards and Clinical Practice Committee." Prehospital Emergency Care **4**(2): 190-5.
[References: 12]

Position paper from National Association of EMS Physicians, included for information.

Bowker, L. and K. Stewart (1999). "Predicting unsuccessful cardiopulmonary resuscitation (CPR): a comparison of three morbidity scores." Resuscitation **40**(2): 89-95.

Level P1 Neutral Good. This study compares and combines three prediction tools, PAM, PAR and MPI. The prediction tools used alone can predict when CPR will be unsuccessful but the sensitivity is low. In combination the tools sensitivity increases but only to 42% and is cumbersome.

McCullough, P. A., R. J. Thompson, et al. (1998). "Validation of a decision support tool for the evaluation of cardiac arrest victims." Clinical Cardiology **21**(3): 195-200.

Level P2 Supportive Good. Retrospective cohort. This study validates a clinical decision support tool for prediction of ROSC or futility. The tool is simple and easily administered and had a demonstrated high sensitivity. The tool is limited to known cardiac arrests and witnessed arrests in the out of hospital group and was a single centre study. Study period from 1989-1996 – therefore 5:1 CPR ratio used..

Morrison, L. J., L. M. Visentin, et al. (2006). "Validation of a rule for termination of resuscitation in out-of-hospital cardiac arrest.[see comment]." New England Journal of Medicine **355**(5): 478-87.

Level P1 Good Supportive The decision rule was no ROSC, no shocks are administered and the arrest is not witnessed by emergency medical services personnel. The rule had a positive predictive value for death of 99.5%. The rule was derived for emergency medical technicians (EMTs) trained in the use of AED (BLS tool).Study period from 2002-2004 – therefore 15:2 CPR ratio used.

Morrison, L. J., P. R. Verbeek, et al. (2007). "Derivation and evaluation of a termination of resuscitation clinical prediction rule for advanced life support providers." <u>Resuscitation</u> **74**(2): 266-75.

Level P2 Good Supportive Retrospective data analysis from OPAL study. Large sample size. The study looked at predictors for death rather than survival with a 100% negative predictive value with a 95% confidence interval. These predictors for death were no ROSC prior to transport, no shock delivered, no bystander CPR and the arrest was not witnessed by bystanders or EMS. The rule was derived for advanced life support paramedics. Extrapolation to prediction of survival may be made but not justified (ALS and BLS tool). Study period from 1998-2003 – therefore potentially 5:1 and 15:2 CPR ratio's could have been used.

Morrison, L. J., B. L. Bigham, et al. (2008). "Termination of resuscitation: a guide to interpreting the literature." Resuscitation 79(3): 387-90.

This is a guide to interpreting the literature regarding this question. This guide highlights the difficulty of interpreting the science when some papers use a rule that was derived using survival and some papers use a rule that was derived using death. Not included on the table as it is really a commentary of the literature.

Morrison, L. J., P. R. Verbeek, et al. (2009). "Validation of a universal prehospital termination of resuscitation clinical prediction rule for advanced and basic life support providers." <u>Resuscitation</u> **80**(3): 324-328.

Level P1 Good Supportive. Secondary analysis of prospective data from Resuscitation Outcomes Consortium Epistry-Cardiac Arrest trial. The rule was to recommend termination of resuscitation when there was no return of spontaneous circulation prior to transport, not shock was given and the arrest was not witnessed by Emergency Medical Services personnel. Limited to cardiac arrest patients. Large sample. The study had a high specificity and a positive predictive value of 99.8 - 100 with a 95% confidence interval. The sensitivity was low however. Therefore the rule applies to the termination of resuscitation rather than the identification of survivors (ALS and BLS tool). Study period from 2006-2007 – therefore 30:2 CPR ratio used.

Ong, M. E. H., J. Jaffey, et al. (2006). "Comparison of termination-of-resuscitation guidelines for basic life support: defibrillator providers in out-of-hospital cardiac arrest." <u>Annals of Emergency Medicine</u> **47**(4): 337-43.

Level P1 Good Supportive. Comparison of three clinical decision rules in out of hospital arrests The rules were applied to a prospective cohort of out of hospital arrests numbering 13,684. The predictive value for death was 100% (Petrie), 99.9% (Verbeek) and 100% (Marsden). All three of these clinical decision rules were for BLS providers who were trained in defibrillation. The study period was from 1998-2003 – therefore potentially 5:1 and 15:2 CPR ratio's could have been used.

Richman, P. B., T. F. Vadeboncoeur, et al. (2008). "Independent evaluation of an out-of-hospital termination of resuscitation (TOR) clinical decision rule." <u>Academic Emergency Medicine</u> **15**(6): 517-21.

Level P1 Good Supportive Independent validation of Morrison's Termination of Resuscitation Decision Rule. Tested in 1,160 patients with only one patient surviving to hospital discharge. Limitation was that is was a retrospective analysis of patient records (BLS tool). Study period from 2004-2006 – therefore potentially 15:2 and 30:2 CPR ratio's could have been used.

van Walraven, C., A. J. Forster, et al. (2001). "Validation of a clinical decision aid to discontinue in-hospital cardiac arrest resuscitations." <u>JAMA: The Journal Of The American Medical Association</u> **285**(12): 1602-1606.

Level P1 Good Supportive The clinical decision aid predicted survival to discharge for those patients who had a witnessed arrest, VT/VF, or a pulse within the first 10min of chest compressions. 327 resuscitations for which patients were discharged from hospital, all but 3 satisfied the decision aid, resulting in a sensitivity of 99.1% (95% CI, 97.1%-99.8%). This was however an in hospital retrospective study of the decision aid and therefore extrapolation to out of hospital arrests weakens the power of the study. Single centre study. Study period from 1987-1996 – therefore 5:1 CPR ratio used.

van Walraven, C., A. J. Forster, et al. (1999). "Derivation of a clinical decision rule for the discontinuation of in-hospital cardiac arrest resuscitations.[see comment]." <u>Archives of Internal Medicine</u> **159**(2): 129-34.

Level P2 Good Supportive. A clinical decision rule was derived from cardiac arrest outcome data of 1077 patients. The clinical rule predicted no chance for survival from hospital discharge if the cardiac arrest lasted 10 minutes or more after cardiopulmonary resuscitation was started and the initial cardiac rhythm was not ventricular tachycardia or fibrillation and the arrest was not witnessed. The sensitivity was 100% (95% CI, 97.5% - 100%. Study period from 1989-1995 – therefore 5:1 CPR ratio used.

ADDITIONAL REFERENCES

Brindley, P. G., D. M. Markland, et al. (2002). "Predictors of survival following in-hospital adult cardiopulmonary resuscitation." <u>CMAJ Canadian Medical Association Journal</u> **167**(4): 343-8.

Level 4 Supportive Fair Retrospective audit of hospital records. Respiratory arrest is a predictor of survival.

Bunch, T. J., C. P. West, et al. (2004). "Admission predictors of in-hospital mortality and subsequent long-term outcome in survivors of ventricular fibrillation out-of-hospital cardiac arrest: a population-based study." <u>Cardiology</u> **102**(1): 41-7.

Level 4 Fair Supportive Retrospective patient record audit. Study limited to VF arrests. Predictor of survival was short defib times, predictor of death were patients on Digoxin and those who had hypertension.

Cohn, A. C., W. M. Wilson, et al. (2004). "Analysis of clinical outcomes following in-hospital adult cardiac arrest." <u>Internal Medicine Journal</u> **34**(7): 398-402.

Level 4 Fair Supportive Prospective patient record audit. 105 patients. Independent predictor of survival was the absence of the need for intubation.

Cooper, S., M. Janghorbani, et al. (2006). "A decade of in-hospital resuscitation: outcomes and prediction of survival?" <u>Resuscitation</u> **68**(2): 231-7.

Level 4 Fair Supportive Prospective audit of patient records. Predictors of survival at 24hrs, Age, Mode of arrest, primary arrhythmia, Time of day, Arrest duration. Predictive ability was 80%. Population was in hospital and only one hospital, however large sample.

Danciu, S. C., L. Klein, et al. (2004). "A predictive model for survival after in-hospital cardiopulmonary arrest.[see comment]." <u>Resuscitation</u> **62**(1): 35-42.

Level 4 Good Supportive Prospective patient record audit. Large sample. Independent predictors of survival at discharge and also at 3 months were higher BMI, presence of chronic renal insufficiency, respiratory arrest, VF/VT and arrest early in the hospital stay. Limited to in hospital arrests.

Di Bari, M., M. Chiarlone, et al. (2000). "Cardiopulmonary resuscitation of older, inhospital patients: immediate efficacy and long-term outcome." <u>Critical Care Medicine</u> **28**(7): 2320-5.

Level 4 Good Opposing Retrospective patient record audit. Age is not an independent predictor of survival of cardiopulmonary arrest.

Gottschalk, A., M.-A. Burmeister, et al. (2002). "Influence of early defibrillation on the survival rate and quality of life after CPR in prehospital emergency medical service in a German metropolitan area." <u>Resuscitation</u> **53**(1): 15-20.

Level 1 RCT Fair Supportive. Early defibrillation was demonstrated to be a prediction to survival. VF arrest group only. <8min Study a little old (1996) Specific population.

Herlitz, J., A. Bang, et al. (2002). "Characteristics and outcome among patients suffering from in hospital cardiac arrest in relation to the interval between collapse and start of CPR." <u>Resuscitation</u> **53**(1): 21-7.

Level 4 Good Supportive Prospective and retrospective patient record audit. Prediction for survival was initiation of CPR of <1min from collapse.

Herlitz, J., S. Rundqvist, et al. (2001). "Is there a difference between women and men in characteristics and outcome after in hospital cardiac arrest?" <u>Resuscitation</u> **49**(1): 15-23.

Level 4 Good Neutral Prospective patient record audit. Large and long study. Females had only a small improvement for survival.

Sandroni, C., G. Ferro, et al. (2004). "In-hospital cardiac arrest: survival depends mainly on the effectiveness of the emergency response." <u>Resuscitation</u> **62**(3): 291-7.

Level 4 Fair Prospective patient record audit. Prediction for survival was shorter time of arrival of resus team. In hospital study.

Skrifvars, M. B., M. Castren, et al. (2007). "Variability in survival after in-hospital cardiac arrest depending on the hospital level of care." <u>Resuscitation</u> **73**(1): 73-81.

Level 4 Poor Supportive In hospital comparative study. Predictors of survival were similar to other studies, age, VF/VT, witnessed cardiac arrest, arrest during office hours. This study was rated as poor as it did not specifically look at predictors for survival of cardiac arrest, that was a by-product of this comparative study amongst survival rates of various hospitals.

Skrifvars, M. B., J. Nurmi, et al. (2006). "Reduced survival following resuscitation in patients with documented clinically abnormal observations prior to in-hospital cardiac arrest." <u>Resuscitation</u> **70**(2): 215-22.

Level 4 Fair Supportive. Predictors for death from in hospital cardiopulmonary arrest were found to be initial rhythm other than VF/VT, un-witnessed arrest, arrival of the resuscitation team longer than 2 min and the presence of documented clinically abnormal observations prior to the arrest (although this was not statistically significant at 12 months post discharge). Extrapolation to prediction of survival may be made but not justified.