Clinical decision making in cardiopulmonary resuscitation

de Vos, R.

Citation for published version (APA):
de Vos, R. (1999). Clinical decision making in cardiopulmonary resuscitation

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
Chapter 4

Survival probability after resuscitation

In-hospital cardiopulmonary resuscitation: pre-arrest morbidity and outcome.
Archives of Internal Medicine (Accepted).
ABSTRACT

Cardiopulmonary resuscitation should only be applied if it is effective, useful and not harmful. The survival probability after resuscitation may be more accurately estimated by the occurrence in time of the pre-arrest morbidity of patients.

Methods
Medical records of resuscitation patients were reviewed. Pre-arrest morbidity was established by categorizing the medical diagnoses according to three functional time frames: before admission, upon admission and during admission. Independent indicators for survival after resuscitation were identified through a logistic regression model. The effect sizes were expressed in odds ratios (OR) with their 95% confident limits (CL).

Results
553 resuscitation patients were included in the study, median age 68 years (range 18-98 years); 22% survived up to hospital discharge. Independent risk factors for lower survival rates were age > 70 years (OR 0.6, CL 0.4 - 0.9), stroke before admission (OR 0.3, CL 0.1 - 0.7) and renal failure before admission (OR 0.3, CL 0.1 - 0.8), and congestive heart failure during admission (OR 0.4, CL 0.2 - 0.9). Indicators for higher survival rates were angina pectoris before admission (OR 2.1, CL 1.3 - 3.3) and ventricular dysrhythmia as main diagnosis upon admission (OR 11, CL 4.1 - 33.7). Based on the logistic regression model, 17% of our resuscitation patients (n=96) was identified as having a high risk for a poor outcome (≤ 10% survival probability).

Conclusions
The time of pre-arrest morbidity has a prognostic value for the survival after resuscitation. Patients at risk for a poor survival can be identified upon or during admission. Although decisions will not be made by the model, its information can be useful for doctors in discussions about the patient’s prognosis.
Doctors have no responsibility to provide futile or unreasonable care, thus cardiopulmonary resuscitation should only be applied if considered effective, useful and not harmful. By excluding patients with an expected poor survival also resources can be saved, although resuscitation should not be withheld just for mere financial reasons. With the exception of a zero survival, there is no consensus about what futile care implies. In case of a zero survival a doctor can withhold resuscitation, even when a patient or family insists. If the survival probability is not zero, discussions with patients are needed about the trade-off between the survival probability and the quality of life after resuscitation. The patients’ preference for resuscitation is influenced by information about the survival probability. However, is it possible to give patients an accurate estimate of this probability? It is, for example, suggested that some doctors can make no better predictions than is to be expected by chance alone.

Formal decision rules could support decisions about resuscitation, but for ethical and statistical reasons doctors and patients remain the decision makers, and rules are not decisive. Unfortunately, the current decision aids have failed to predict survival. In agreement with the literature, these decision aids consider the age of the patient, the level of self care and presence or absence of morbidity before resuscitation. The fact that morbidities occur over time is not considered. This time can be divided in three functional time frames: morbidity before admission, morbidity as reason for hospital admission, and morbidity emerging during admission. The distinction is clinically relevant as ideally a do-not-attempt-resuscitation order should be discussed with every patient upon admission, and adjusted after clinical relevant changes in health. As yet, no data are available about the prognostic relevance to identify these time frames. In view of the need to support doctors in their decision making process, our objective was to identify risk factors for a poor survival in relation to the dynamics of pre-arrest morbidity.

**PATIENTS AND METHODS**

We studied cardiac arrests in the Academic Medical Center (tertiary care hospital, 1030 beds; annually 26,000 admissions) between June 1988 and December 1994. The 24-hours resuscitation team consisted of an anesthesiology resident, a cardiology resident and an anesthesiology nurse. The team provided Advanced Life Support to patients on all nursing wards and in the emergency room, according to a protocol based on the guidelines of the American Heart Association and the European Resuscitation Council. Basic Life Support was initiated by ward nurses. The hospital policy is to always...
initiate resuscitation in case of cardiac arrest, unless a do-not-attempt-resuscitation-order is present. Cardiopulmonary resuscitation was defined as the application of artificial ventilation and external chest compressions after confirmed loss of palpable pulse or immediate defibrillation after confirmed ventricular fibrillation.

The study cohort consisted of all consecutive patients of 18 years and older with an in hospital cardiac arrest and an attempted resuscitation by the resuscitation team. We excluded patients with (a) an out-of-hospital cardiac arrest, and (b) a second and subsequent cardiac arrest during the same admission. The study protocol was approved by the medical ethics committee.

The calls for the resuscitation team were identified through automatically recorded tapes at the central hospital telephone switchboard. After each call, the resuscitation team completed a detailed standard form. Medical records of resuscitation patients were evaluated by two reviewers. Patient characteristics included age, sex and functional status before admission. Medical diagnoses were defined as relevant if the medical records marked them as a significant problem without setting strict quantitative criteria for severity of illness. The medical diagnoses were coded and clustered according to the International Classification for Diseases (ICD-9). Cardiac disorders were defined as ICD-9 codes 391 to 429, pulmonary embolism (415) was excluded. All other codes, 415 included, were classified as ‘noncardiac’.

Time frames
Before hospital admission patients can have one or more morbidities, the main indication for admission will be determined by one of these. During admission new morbidities may develop, and accordingly, we categorized the medical diagnoses in three functional time frames: morbidity before admission, main morbidity on admission and new morbidity during admission. Morbidities before admission included all active disorders which required treatment (e.g. cancer), as well as inactive disorders with expected late effects present in the year before admission (e.g. myocardial infarction). As main morbidity on admission, we selected one morbidity as the primary admission diagnosis. New morbidities during admission were defined as emerging disorders occurring from the day of admission up to 24 hours before the cardiopulmonary arrest. Morbidities developing within 24 hours of the arrest were expected too acute to be of influence to a do-not-attempt-resuscitation order.

All morbidities were analyzed, but only presented if their prevalence was ≥ 1% or if previous studies indicated a relationship with the outcome after resuscitation; outcome was survival at the time of hospital discharge.

Statistical analysis
Differences in survival associated with patient characteristics and morbidities
before, upon and during admission were analyzed with the Chi-square statistic, and expressed in relative risks (RR) with 95% confidence limits (CL). In multivariate analysis, all morbidities associated with the outcome after resuscitation with a p-value ≤ 0.20 at the univariate level, as well as the patient characteristics were entered into a logistic regression model. We used the outcome on discharge (death or survival) as dependent variable (software SPSS 6.1.1). Significant independent explanatory factors were identified by backward elimination. The effect sizes were expressed in odds ratios (OR) with their 95% confident limits (CL). Interaction was investigated between the main factors and a biological plausible subset of comorbidities. Calibration of the model was assessed with the Hosmer-Lemeshow goodness of fit test. This test compares observed and expected frequencies of the outcome in groups based on the values of the estimated probabilities, using the logistic model. Additionally, we plotted a calibration curve comparing the observed percentages of survival and the estimated probabilities by the logistic model. Results were statistically significant with values of p < 0.05.

RESULTS

The resuscitation team received 1398 emergency calls which included: true cardiopulmonary arrests (n = 850), respiratory arrests only (n = 182), and medical emergencies for which resuscitation was not required (n = 366). From the 850 patients with cardiopulmonary arrests, we excluded from the analysis: patients declared dead upon arrival of the team (n = 11), those with the age < 18 years (n = 63), patients after out-of-hospital cardiopulmonary arrest ongoing into the emergency room (n = 170), and second or later arrest in one and the same patient (n = 48). The medical records of 5 patients could not be traced. A total of 553 resuscitation patients entered the study, 317 men and 236 women with a median age of 68 years (range 18-98 years). Up to hospital discharge 120 patients (22%) survived. No association was found between gender and survival. Patients up to the age of 70 years (n = 287) were more likely to survive than older patients (n = 266) (25% vs. 18%, RR 1.4, CL 1.0 - 2.0). Patients who were functionally independent before admission (n = 494) were nearly twice as likely to survive as those who were functionally dependent (n = 59) (23% vs. 12%, RR 1.9, CL 0.9 - 3.9).

Morbidities before admission

There was no difference in survival associated with the presence or absence of morbidity before admission (22% vs. 22%). When morbidities were present before admission, significant differences in survival existed between the morbidities. Survival was significantly higher in patients with only a cardiac.
morbidity than in those with only noncardiac or combined cardiac and non-cardiac morbidities (30% vs. 17%, RR 1.8, CL 1.3 - 2.4). Particularly angina pectoris was associated with a relatively high survival (30%) (Fig 4.1.). No survival was found in noncardiac morbidities like AIDS, gastrointestinal bleeding, pneumonia, psychiatric disorders, and sepsis. A relatively low survival (≤ 10%) was found in case of cirrhosis (10%), renal failure (9%), stroke (9%) and transient ischemic attacks (TIA, 8%). Morbidities with a poor survival showed a low prevalence and consequently wide confidence limits (e.g. sepsis). This with the exception of renal failure and stroke.

**Main morbidity on admission**

A few morbidities which were the indication for hospital admission were significantly associated with survival after resuscitation. Survival with a cardiac morbidity on admission was significantly higher than with a noncardiac morbidity (29% vs. 15%, RR 2.0, CL 1.4 - 2.7). A relatively high survival was observed in case of angina pectoris (37%) and ventricular dysrhythmia (70%) (Fig 4.2.). A relatively low survival was found in noncardiac morbidities, such as an aortic aneurysm (6%). No survival was observed in AIDS, chronic obstructive pulmonary disease (COPD), gastrointestinal bleeding, liver or pancreas disorders, pneumonia, or psychiatric disorders.

**New morbidities during admission**

During admission 47% of the patients developed a new morbidity. Survival was significantly higher without than with a new morbidity (30% vs. 13%, RR 2.4, CL 1.6 - 3.4). Survival between new cardiac morbidity or new noncardiac morbidity was not significantly different (18% vs. 22%, RR 0.81, CL 0.5 - 1.3). Congestive heart failure occurred relatively frequent during admission, and was significantly associated with low survival (≤ 10%, Fig 4.3.). Low survival was also observed with emerging noncardiac morbidities, such as gastrointestinal disorders and bleeding (9%), renal failure (5%) and sepsis (8%).

**Independent factors explaining outcome**

When all univariately identified (co)morbidities (p value ≤ 0.20), and patient characteristics (sex, age and functional status before admission) were entered into a multivariate logistic regression model, six factors turned out to be independently associated with survival (Table 4.1.). An age of 70 years and older, stroke and renal failure before admission, and congestive heart failure during admission were independently associated with a lower probability survival, while angina pectoris before admission and ventricular dysrhythmia as main admission diagnosis were associated with a higher probability survival.

We could not demonstrate significant interactions between the different factors. The Hosmer Lemeshow goodness-of-fit statistic was not significant.
Figure 4.1. Morbidity before admission in relation to survival after resuscitation

Morbidity before admission included all active disorders requiring treatment, and inactive disorders with expected late effects. Differences in survival associated with morbidities before admission were expressed in relative risks (RR) with 95% confidence limits. Morbidities with a poor survival showed a low prevalence and consequently wide confidence limits (e.g. sepsis). This with the exception of renal failure and stroke.
Figure 4.2. Main morbidity upon admission in relation to survival after resuscitation
As main morbidity upon admission we selected one pre-existing morbidity as the reason for hospital admission (primary admission diagnosis). Differences in survival associated with main morbidities upon admission were expressed in relative risks (RR) with 95% confidence limits. A relatively high survival was specifically observed in case of angina pectoris (37%) and ventricular dysrhythmia (70%).

Survival probability
<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Non Cardiac</th>
<th>Absence of morbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina pectoris</td>
<td>AIDS</td>
<td>(-)</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>Aorta aneurysm</td>
<td>(-)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>Cancer</td>
<td>(-)</td>
</tr>
<tr>
<td>Ventricular dysrhythmia</td>
<td>Cirrhosis</td>
<td>(-)</td>
</tr>
<tr>
<td>Conduction system dis.</td>
<td>COPD</td>
<td>(-)</td>
</tr>
<tr>
<td>Valvular failure</td>
<td>Diabetes mellitus</td>
<td>(1)</td>
</tr>
<tr>
<td>Other cardiac</td>
<td>Gastrointestinal disorders</td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>Gastrointestinal bleeding</td>
<td>(2)</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>Liver/pancreas disorders</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>Metabolic disorders</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>Pneumonia</td>
<td>(5)</td>
</tr>
<tr>
<td></td>
<td>Psychiatric disorder</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>Renal failure</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>Sepsis</td>
<td>(4)</td>
</tr>
<tr>
<td></td>
<td>Stroke</td>
<td>(&lt;1)</td>
</tr>
<tr>
<td></td>
<td>TIA</td>
<td>(-)</td>
</tr>
<tr>
<td></td>
<td>Other non cardiac</td>
<td>(10)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Prevalence (%) #</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(&lt;1)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>(-)</td>
<td></td>
</tr>
<tr>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>(&lt;1)</td>
<td></td>
</tr>
<tr>
<td>(10)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 4.3. **New morbidity during admission in relation to survival after resuscitation**

New morbidities during admission were defined as emerging disorders from the day of admission up till 24 hours before the cardiopulmonary arrest. Morbidities developing within 24 hours of the arrest were considered too acute to be of influence to a do-not-attempt-resuscitation order. Differences in survival associated with new morbidities during admission were expressed in relative risks (RR) with 95% confidence limits. Survival was significantly higher when no new morbidity developed than when a new morbidity emerged (30% vs. 13%).
Survival probability

(p = 0.70), indicating a well calibrated model. The calibration curve compared the observed percentages of survival and the estimated probabilities, using the logistic model (Fig. 4.4.). The figure shows that the predicted survival was 30% or less in the great majority of patients (87%). In this subgroup we found a close concordance between the observed survival percentages and the predicted survival probabilities. Ninety-six patients (17%) fell in the subgroup of an estimated survival of 10% or less. In this low-probability group, 6 patients (6%) survived up to discharge from the hospital. With a predicted survival probability of more than 30% (13% of the patients), the prediction model became less certain.

Table 4.1. Patient characteristics and morbidity patterns explaining survival after cardiopulmonary resuscitation: logistic regression model

<table>
<thead>
<tr>
<th>Age</th>
<th>no of patients</th>
<th>no survived (%)</th>
<th>odds ratio</th>
<th>95% CI</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 70 years</td>
<td>287</td>
<td>73 (25)</td>
<td>0.6</td>
<td>0.4 to 0.9</td>
<td>0.02</td>
</tr>
<tr>
<td>≥ 70 years</td>
<td>266</td>
<td>47 (18)</td>
<td>0.3</td>
<td>0.1 to 0.7</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Before admission

- no stroke
  - 499
  - 115 (23)
  - 0.3
  - 0.1 to 0.8
  - 0.03

- stroke
  - 54
  - 5 (9)
  - 0.3
  - 0.1 to 0.7
  - 0.01

Before admission

- no renal failure
  - 507
  - 116 (23)
  - 0.3
  - 0.1 to 0.8
  - 0.03

- renal failure
  - 46
  - 4 (9)
  - 0.3
  - 0.1 to 0.7
  - 0.01

Before admission

- no angina pectoris
  - 407
  - 76 (19)
  - 2.1
  - 1.3 to 3.3
  - 0.001

- angina pectoris
  - 146
  - 44 (30)
  - 2.1
  - 1.3 to 3.3
  - 0.001

Upon admission

- no ventricular dysrhythmia
  - 533
  - 106 (20)
  - 11.0
  - 4.1 to 33.7
  - <0.001

- ventricular dysrhythmia
  - 20
  - 14 (70)
  - 11.0
  - 4.1 to 33.7
  - <0.001

During admission

- no congestive heart failure
  - 494
  - 112 (23)
  - 0.4
  - 0.2 to 0.9
  - 0.03

- congestive heart failure
  - 59
  - 8 (14)
  - 0.4
  - 0.2 to 0.9
  - 0.03

Survival probability
DISCUSSION

Together with other considerations, decisions whether or not to attempt resuscitation also concern the probability of survival, but predictions about survival are difficult to make. To support the decisions, we studied pre-arrest morbidity related to the time of occurrence to provide more detailed information. The general survival in our patient group was 22%. Risk factors for poor survival were older age of the patient, stroke and renal failure before admission (OR 0.6, 0.3, 0.3 respectively) and congestive heart failure during admission (OR 0.4). Indicators for a relative good survival were angina pectoris before admission and ventricular dysrhythmia as reason of admission (OR 2.1, 11.0). These morbidities had no detectable influence on the outcome when occurring in the other time frames.
Patients without new morbidities during admission fared better than those with new morbidities (RR 2.4). In general and for specific diseases, it can thus be relevant to make a distinction in the time of occurrence of morbidities.

Based on this distinction, 17% of our patients (96/553) could be identified as a high risk group for a poor outcome (≤ 10%) before resuscitation. Six of these patients (6%) survived up to hospital discharge. There is no clinical and scientific consensus about the remotest probability of survival when resuscitation is no longer worthwhile to undertake, except the probability of zero. Our study shows also that some patients can survive against all odds. This does not mean that our information is worthless for clinical purposes. Probabilities offer useful information for doctors, in discussions about the prognosis of patients, and also to elicit patient preferences for resuscitation. However, solely the use of probabilities as binary predictors for making treatment decisions for individual patients can be misleading, even when the model performance is overall good. Although remote, there will always be a chance that patients survive. Furthermore, it should be realized that models are useful for the description of groups of patients, but that their performance may vary considerably for the individual patient. Consequently, decisions purely based on models must be approached with caution.

Our study concentrated on adult patients with specific diagnoses, a population which can generally be found in hospitals. For this reason patients with a cardiac arrest outside the hospital were excluded, because they are a different target group and their determinants of survival are not primary related to pre-arrest morbidity. We also excluded patients with multiple cardiac arrests. Their clinical history is complex (multiple ICU admissions, mechanical ventilation, coma), and the outcome depends on this history. This is an important group of patients, but different from the others, and should receive separate research attention. Patients who also were excluded in our study are for example trauma patients or children. If other studies give also no information about the probability of survival of these patients, resuscitation is to be recommended if a cardiac arrest occurs.

We did not consider acute morbidities which occur within 24 hours before cardiac arrest. In our hospital, decisions not to attempt resuscitation are taken after ample deliberation by senior doctors who are only present during the day. Furthermore, it is our clinical experience that in acute situations, such as severe hemorrhage, one does not withhold resuscitation but attempts to save the life of the patient even when the chances of success are known to be remote. If the patient survives such an event, resuscitation in case of recurrence of the hemorrhage is discussed. Therefore, it is reasonable to consider these acute events of little or no influence on resuscitation decisions. We did not set specific criteria for the severity of illness. It is beyond doubt that this is a highly clinically relevant issue and can further precise our estimates, but
there are no well accepted severity classifications for every disease.

When studying medical records, it is also difficult to categorize patients in such classifications, if they exist. Furthermore, such an exercise would have led to many subgroups of patients and would have diminished the statistical power to detect relevant differences in outcome. It remains unclear how other authors have dealt with the aspect of severity of illness. Apart from this, some discriminative power may have been lost by distinguishing time frames. That is, the identified risk factors were highly prevalent and less frequent potential risk factors may have remained undetected due to their low prevalence in some time frames, e.g. sepsis. This may specifically be the case for new morbidities which occurred during admission.

Our idea to study pre-arrest morbidity is not unique, but differentiation of pre-arrest morbidities in relation to time frames is, to our knowledge, a new approach. Others used for the prediction of the outcome information of clinical events during or after resuscitation, or focused on its immediate success. By design, models which use information during or after resuscitation, have little meaning for decisions about resuscitation, which take place before cardiac arrest. George et al. proposed a Pre-Arrest Morbidity index to predict the outcome. However, they measured the pre-arrest morbidity rather static in terms of presence or absence of morbidity. A recent study by Ebell et al. showed that different models, based on static evaluation of pre-arrest morbidity, failed to predict the survival after resuscitation. So far, our model particularly explains poor outcome after resuscitation, but to be accepted as a decision model more research is needed in terms of reliability, and discriminative ability, as well as internal and external validity.

Some risk factors in our study are known, but stroke and congestive heart failure were previously considered weak predictors. This may illustrate the effect of whether a distinction is made between time frames. In our study, for example, congestive heart failure was no risk factor as pre-admission morbidity or morbidity on admission, while it was a potent risk factor when emerging during admission. It is likely that if we had considered the total occurrence of congestive heart failure over the three time frames, the prognostic value of heart failure during admission would have been ‘diluted’, and consequently we would have reported similar results as other authors.

Cardiac morbidity before admission and upon admission was associated with a nearly twofold higher survival than in noncardiac morbidity (RR 1.8 and 2.0). During admission, survival in case of cardiac morbidity equalled that of noncardiac morbidity. The ‘advantage’, in terms of survival, of having a cardiac morbidity thus depends on the time frame. This may be caused by a lower incidence of ischemic cardiac diseases during admission than in the other time frames, and/or by a relatively acute onset in this phase.

There are many competing arguments why patients with cardiac morbidities
fair better after resuscitation than those with noncardiac morbidities, such as the difference of initial heart rhythm at cardiac arrest, monitoring before cardiac arrest, or severity of illness. It would be of interest to investigate these arguments in subgroups of patients.

In this study, we demonstrated that cardiac arrest occurs in a heterogeneous group of hospitalized patients and that we can make inferences about the outcome after resuscitation in relation to morbidities in different time frames. Ideally a do-not-attempt-resuscitation order should be discussed with every patient upon admission, and adjusted after clinical relevant changes in his or her health. Our model is not a decision rule which replaces such a discussion. When deciding upon a do-not-attempt-resuscitation order, decision makers may feel discomfort with prognostic information, particularly when the chance of survival is small but not zero. For a balanced decision additional aspects as quality of life and patient preferences must also be considered. Nevertheless, the decisions will be made with more confidence if the information on survival after resuscitation is improved. Our model based on time frame dependent morbidities may give such supportive clinical information.

REFERENCES

1. Luce J. Physicians do not have a responsibility to provide futile or unreasonable care if a patient or family insist. Crit Care Med 1995;23:760-766.