Critical Review Form

Clinical Prediction or Decision Rule

Derivation of a Termination-of-resuscitation Guideline for Emergency Medical Technicians Using Automated External Defibrillators, *Acad Emerg Med* 2002; 9: 671-678

Objectives: **"To determine the association between various characteristics of out-of-hospital cardiac arrest and survival in patients treated exclusively by EMT-Ds and to propose an out-of-hospital TOR guideline for EMT-Ds". (p. 672)**

Methods: **Retrospective review of the single Toronto EMS service serving 2.2 million people with 500 EMT-Ds and 150 ALS paramedics, but firefighters serving as the primary responders for 80% of the 1500 annual out-of-hospital cardiac arrests. Furthermore, among the 20% with EMS responders, 25% are solely EMT-D. Following explicit chart review methods, investigators abstracted data for all out-of-hospital cardiac arrests for Jan 1998 and May 1998 through Jan 31, 2000 from ambulance reports, computer-aided dispatch records, fire service reports, and AED recordings. Exclusion criteria included traumatic arrests, drowning, drug overdose, pre-hospital ACLS care, possession of DNR document or age < 18 years.**

The primary outcome was patient-oriented: pronounced dead in the ED; admitted from the ED but subsequently died; admitted and survived to discharge. The Office of the Chief Coroner records was reviewed if hospital records were incomplete.

Bivariate associations were analyzed using SAS with appropriate tests for categorical, non-parametric continuous, or continuous data. Significant variables were then entered into multivariate logistic regression analysis to derive the BLS TOR guideline.

I.	***Is this a newly derived instrument* (Level IV)?**	
A.	Was validation restricted to the retrospective use of statistical techniques on the original database? (If so, this is a Level IV rule & is not ready for clinical application).	Validation strictly retrospective, therefore Level IV CDR.
II.	**Has the instrument been validated? (Level II or III). If so, consider the following:**	
1a	Were all important predictors included in the derivation process?	Investigators only considered five variables for their model: bystander CPR, witnessed by bystander, witnessed by EMS, shock given prior o transport and ROSC prior to transport (Fig 2, p. 675). Additional variables might have included age, pre-arrest functional status, prior cardiac arrest, defibrillator, CHF history, and response time. Although investigators don't discuss contemplation of all these variables, they mention that response times are heterogeneously recorded and should not be used in retrospective analyses.
1b	Were all important predictors present in significant proportion of the study population?	Yes. Field ROSC 5%, bystander CPR 16%, shock prior to transport 25%, witnessed by EMS 13%, and witnessed by bystander 40%.
1c	Does the rule make clinical sense?	Yes, each candidate variable has content and face validity.
2	Did validation include prospective studies on several different populations from that used to derive it (II) or was it restricted to a single population (III)?	No validation occurred so this remains a Level IV CDR.
3	*How well did the validation study meet the following criteria?*	
3a	Did the patients represent a wide spectrum of severity of disease?	No, generally elderly population (Table 1, op. 673). Of note, lost to follow-up subset older and more likely female.
3b	Was there a blinded assessment of the gold standard?	Yes. "The data abstractors were aware that we sought to determine the proportion of cardiac arrest survivors in our case sample but not that a TOR guideline would be developed." (p 673)
3c	Was there an explicit and accurate interpretation of the predictor variables & the actual rule without knowledge of the outcome?	Uncertain about reproducibility of variables since retrospective with no Kappa analysis but the findings were recorded by EMS before BLS TOR developed or outcomes known.

3d	Did the results of the assessment of the variables or of the rule influence the decision to perform the gold standard?	Uncertain whether knowledge of outcome known before the variables were recorded. Similarly, uncertain whether outcomes (ROSC vs. scene declaration) would influence recall or documentation detail.
4	How powerful is the rule (in terms of sensitivity & specificity; likelihood ratios; proportions with alternative outcomes; or relative risks or absolute outcome rates)?	• 5.4% of cardiac arrest cases had insufficient follow-ups and were excluded, leaving 662 for analysis. • Among the 662, 5.4% (36) had ROSC in the field. Of the 36, 18 (50%) died after hospital admission, but 11 (30%) survived to hospital discharge. • Among the 626 without ROSC in the field, 588 died in the ED, 36 died following hospital admission, and 2 (0.3%, 95% CI 0.04-1.2%) survived to hospital discharge. • Logistic regression identified three independent predictors of survival to hospital discharge: ROSC prior to transport (OR 46); shock prior to transport (OR 6.9,95% CI 1.2-4.0); and EMS witnessed cardiac arrest (OR 4.4, 95% CI 1.0-18.5). • Lacking any of these three features (meaning terminate BLS), the BLS TOR had the following prognostic test performance. Sen 65 (65 – 65.5%) Spec 100 (78 – 100%) LR+ ∞ LR- 0.34 (0.34 – 0.45) Died / Lived Terminate BLS 425 / 0 Continue BLS 224 / 13

III.	**Has an impact analysis demonstrated change in clinical behavior or patient outcomes as a result of using the instrument? (Level I). If so, consider the following:**	
1	How well did the study guard against bias in terms of differences at the start (concealed randomization, adjustment in analysis) or as the study proceeded (blinding, co-intervention, loss to follow-up)?	No randomization and no prospective validation or application of the rule. Potential selection bias by retrospective design.
2	What was the impact on clinician behavior and patient-important outcomes?	No assessment of impact o acceptance of BLS TOR, however use of the 3-item rule would have reduced transport from 100% to 35.8% without missing any of those surviving to hospital discharge. Further simplifying the rule, if only considering those without ROSC in the field only 30% would have been transported and two (1%) would have survived to hospital discharge.

Limitations

1) **Single-center design and retrospective derivation without validation limit BLS TOR to Level IV CDR without external validity pending prospective validation.**

2) **EMT-D analysis may not apply where EMT-paramedics predominate with ALS capabilities.**

3) **Multiple variables not included in the derivation process including age, pre-arrest functional status, comorbidity index, prior cardiac arrest, indwelling AICD, or response times. However, many (or all) of these variables are not readily available during pre-hospital arrest rescue efforts.**

4) **No assessment of abstractor reliability (Kappa). Future research will need to demonstrate that BLS TOR can be replicated. In other words, if two EMT's evaluate the same patient will they obtain the same BLS TOR result?**

5) **Insufficient explanation of patient important outcome: neurologically intact hospital discharge.**

6) **No assessment of EMT, nursing, physician, or societal acceptance of pre-hospital BLs TOR or acceptable miss thresholds.**

7) **Insufficient demographic patient descriptors to permit assessment of how well these findings generalize to our pre-hospital population.**

8) **No sensitivity analysis of those lost to follow-up.**

Bottom Line

BLS TOR, a 3-item rule with 100% sensitivity in Toronto EMT-D pre-hospital cardiac arrest populations offers the possibility to avoid unnecessary, dangerous ambulance transfers in the majority of arrests but prospective validation is required in multiple institutions before widespread implementation of pre-hospital termination of cardiac arrest can be safely recommended.