Critical Review Form
Clinical Prediction or Decision Rule

Derivation and evaluation of a termination of resuscitation clinical prediction rule for advanced life support providers, *Resuscitation* 2007; 74:266-275

Objectives: **"To derive a new ALS TOR clinical prediction rule by determining the relationship between out-of-hospital cardiac arrest variables and the primary outcome of survival to hospital discharge. In addition, the pronouncement rate and diagnostic test characteristics of the ALS TOR clinical prediction rule will be measured and compared to the BLS TOR clinical prediction rule measures in the same patient cohort." (p. 268)**

Methods: **This was a secondary analysis of the OPALS study, a before/after prospective cohort of 21 urban and rural Ontario communities. Exclusion criteria included age < 16 years, obviously long-dead (rigor mortis, lividity decomposition or decapitation), ALS available before ambulance arrival, DNR orders presented to paramedics, or steering committee determination of non-arrest. The primary outcome was survival to hospital discharge s determined by chart review and contact with the family physician.**

Fifteen variables were evaluated for inclusion in the ALS TOR CDR: system response < 8 min; patient response < 8 minutes; bystander witnessed cardiac arrest; EMS witnessed cardiac arrest; initial rhythm of VT or VF; bystander initiated CPR; fire department or police initiated CPR; EMT-D initiated CPR; EMT-P initiated CPR; first defibrillation administered from public access AED; first defibrillation administered by fire department/police first responder; first defibrillation administered by EMT-D; first defibrillation administered by EMT-P; any return of spontaneous circulation; any defibrillation during the entire ambulance run.

Bivariate analysis was used to identify significant candidate variables for logistic regression model building. Since many co-variates are related (shock delivered and initial rhythm VF/VT, for example) only one-member of related pairs was included when multiple pairs were significant. Further model reduction occurred by starting with ROSC as the sole independent variable and then sequentially adding co-variates with retention of subsequent co-variates only when survival estimate improved by ≥ 10%

The resulting model was statistically validated by bootstrap simulation without resulting in any variables or variable risk ratio significance changes. Goodness of fit for the models were confirmed with the Hosmer-Lemeshaw test and prognostic test performance figures reported. Sample size was adequate for the criterion 10 observations per variable.

Guide		Comments
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).	Yes, this rule has been retrospectively derived and validated so it is a 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?	Yes, see above. The list of 15 Utstein variables is all-encompassing.
1b	Were all important predictors present in significant proportion of the study population?	Uncertain since the prevalence of each variable is not reported.
1c	Does the rule make clinical sense?	Yes, each component of the ALS TOR CDR 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, so this paper cannot elevate the ALS TOR to a Level III CDR.
3	*How well did the validation study meet the following criteria?*	
3a	Did the patients represent a wide spectrum of severity of disease?	Scant demographic data is provided so we cannot confidently answer this question.
3b	Was there a blinded assessment of the gold standard?	Yes. Outcomes were determined in OPALS study before ALS TOR was even conceived.
3c	Was there an explicit and accurate interpretation of the predictor variables & the actual rule without knowledge of the outcome?	Unknown since EMS training and data abstractor inter-rater reliability not reported.
3d	Did the results of the assessment of the variables or of the rule influence the decision to perform the gold standard?	No, all subjects were presumably transported to the ED by Ontario pre-hospital protocol.

4	How powerful is the rule (in terms of sensitivity & specificity; likelihood ratios; proportions with alternative outcomes; or relative risks or absolute outcome rates)?	• From 5274 cardiac arrests, 599 were excluded leaving 4673 for analysis with 66% male and mean age 69. • Reported missing data included times (2.4%) and initial ECG rhythm (4%). Less than 1% were lost to follow-up. • In the cohort analyzed 671/4673 (4%) were admitted and 239/4673 (5.1%) survived to hospital discharge. The majority (341/4673 or 82%) did not have ROSC during resuscitation and of these only three (0.08%; 95% CI 0.02 – 0.23%) survived to hospital discharge. • ALS TOR CDR (below) displayed the following prognostic test characteristic Sen 100 (98.4 – 100) Spec 32 (31.9 – 32) NPV 100 (99.7 – 100) PPV 7 (7.2 – 7.3) LR- 0 (0 – 0.05) LR+ 1.5 Survival Death Transport to ED 239 3015 Terminate efforts 0 1419 • By comparison BLS TOR had 100% sensitivity and 50% specificity with NPV 100% (99.9 – 100%). • If applied in the field ALS TOR pronouncement rate would be 30% and BLS TOR would be 48%.

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 impact analysis was performed by retrospective design subject to multiple forms of bias and model over-fitting so needs prospective validation before widespread use.
2	What was the impact on clinician behavior and patient-important outcomes?	No impact on clinician behavior because not prospectively applied.

Limitations

1) **Level IV CDR retrospectively derived and validated so requires prospective validation to ensure that health are providers accurately and comfortably apply ALS TOR in real-time pre-hospital settings.**

2) **No demographic data provided on EMS level of experience.**

3) **No data abstractor inter-rater reliability assessment reported.**

4) **Ontario-based report may limit external validity of the findings to other pre-hospital settings. For example, if St. Louis EMS had a 30% pre-hospital arrest survival rate they might not find ALS TOR necessary or acceptable.**

Bottom Line

The ALS TOR, a retrospectively derived pre-hospital decision aid accurately identifies all cardiac arrest victims who will survive to hospital discharge (sensitivity 100%; 95% CI 98.4 – 100%). Theoretically, pre-hospital use of ALS TOR would permit field pronouncement in 30% of cases saving the unnecessary hospital transport of these patients. BLS TOR also had 100% sensitivity with better specificity than ALS TOR (50% vs. 32%) and would have permitted field pronouncement rates of 48%. ALS TOR will require prospective validation on different patient populations before widespread application of this CDR can be supported.

ALS TOR

Transport to the ED if any of the following pre-hospital findings are noted in suspected cardiac arrest:

1) Arrest witnessed by EMS personnel
2) Bystander witnessed the cardiac arrest
3) Bystander CPR as performed
4) A shock was delivered
5) There was ROSC (prior to transport)

Otherwise, *consider* termination of resuscitation efforts.