and causes of acute decompensation in patients who were admitted to the ICU for pulmonary embolus.

Researchers conducted a single-center retrospective cohort study of patients who were admitted to either medical or surgical ICU for PE during an eight-year period from 2010-2017. Patients were excluded if they had another reason to need ICU-level care, if they were admitted to the floor, if they were already intubated or started on vasopressors at the time of ICU admission, or if they received thrombolytics or mechanical clot disruption prior to admission. The primary outcome was hemodynamic decompensation, defined as a need for use of vasopressors within 48 hours of admission. Secondary outcomes include in-hospital mortality, need for other interventions, major bleeding events, and length of stay. Additional sensitivity analyses were also performed, including patients with biochemical or radiographic evidence of RV strain, patients with saddle PE, patients who were admitted to the ward who were subsequently transferred to the ICU. They also extended the decompensation window to 72 hours from 48 hours.

A total of 293 patients were included in the study. Of those 293 patients, only 8 had hemodynamic compromise during the first 48 hours of their ICU stay. When comparing the 2 groups, the patients who decompensated were more tachypneic at presentation (RR 29 vs. 21, $p<0.001$) and had higher Brain Natriuretic Peptide (BNP) levels (3133 vs 1265pg/ml, $p=0.04$). There was no statistical difference in troponin levels, comorbidities, PE size, or right ventricular dysfunction. Causes of decompensation included: medications (1), left ventricular dysfunction (1), sepsis (1), PE/RV dysfunction (2), bleeding (2), and bleeding and/or RV dysfunction (1). In the cohort of 100 patients initially admitted to the floor, no one experienced hemodynamic decompensation during the first 48 hours of their ICU stay. There were no additional patients who experienced hemodynamic compromise when the time period was expanded to 72 hours. When looking at only the patients with a saddle PE, only 1 of the 88 patients experienced decompensation. When looking at patients with evidence of right heart strain on both imaging and laboratory studies, 7 of the 172 patients experienced decompensation. Of these 172 patients, 14% of them received thrombolytics and none of these patients experienced decompensation.

The authors concluded that hemodynamic decompensation during the first 48 hours of admission was rare for patients who presented with an acute pulmonary embolus and were normotensive. While RV dysfunction was one of the most common causes of hemodynamic instability, hemorrhage was just as common and needs to be considered in this patient population.

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Comment: Though this is a limited single center retrospective study, it sets the stage for future to help determine whether patients with findings of "significant" PE (saddle embolus, RV strain, etc) could actually be safely managed on the floor as opposed to in an ICU. The number of patients that decompensated in this study is low, which suggests that rates of decompensation are low in normotensive patients who present with acute PE. While this sounds promising, we must remember that it can be difficult to attempt to delineate risk factors for very rare outcomes.

☐ A SIMPLE DECISION RULE PREDICTS FUTILE RESUSCITATION OF OUT-OF-HOSPITAL CARDIAC ARREST.

Nancy K Glober, Christopher R Tainter, Tiffany M Abramson, et al. *Resuscitation*, 2019;142;8-13

Emergency Department (ED) physicians are commonly called upon to continue resuscitation efforts on patients who have suffered out of hospital cardiac arrest (OHCA) and have achieved Return of Spontaneous Circulation (ROSC) in the field. Rates of reported survival to hospital discharge range from 3-20% and resuscitation cost has been reported at $118,000, regardless of outcome. Risks of futile resuscitation efforts include emotional and financial trauma to family members and burden on limited healthcare resources. This study seeks to establish a decision rule with high reliability in predicting futile resuscitation of OHCA and thus influence Termination of Resuscitation (TOR) guidelines in the field.

A retrospective cohort analysis was performed using the Cardiac Arrest Registry to Enhance Survival (CARES) database to review all OHCAs in San Mateo county, CA to which paramedics were dispatched from 2015-2018. Researchers collected the following data: patient demographics, arrest characteristics (location, witnessed vs unwitnessed, initial rhythm), defibrillation, whether or not bystander CPR was performed, on-scene time and transport time, and patient survival to ED, to admission and to hospital discharge. Recursive bipartite partitioning was then used to develop the simplest decision rule that would be 100% specific in predicting failure to survive to hospital discharge. Separate analysis was performed to assess if there were different characteristics that would lead to survival with good neurologic function, defined as a CPC score of 1 or 2.

A total of 1706 patients were treated for OHCA and met the inclusion criteria. They found that following criteria predicted failure to survive: age > 80 years, unwitnessed arrest, and non-shockable initial rhythm. These three criteria were present in 13.1% of patients, none of whom survived to hospital discharge. They suggest the NUE rule (Non-shockable, Unwitnessed, Eighty or older) was 14.4% sensitive and 100% specific in predicting non-survival. When the rule was modified to include age > 80 years, non-shockable rhythm, and arrest at home, it encompassed 17.4% of arrest patients, none of whom survived to have good neurologic outcomes. The rule was found to be 18.6% sensitive and 100% specific for this metric. Age was the least important predictor in this analysis, while absence of shockable rhythm was the most important.

The authors conclude that these 3-element decision rules have the potential to improve utilization of healthcare resources and reduce trauma to family of those who suffer OHCA. They favor use of the more conservative rule predicting death rather than poor neurologic outcome as a guideline for Termination of Resuscitation in the field due to the more complex issues surrounding the definition of neurologic outcomes and potential differences in family and provider preferences regarding this concept. The authors acknowledge that study participants

were from a single county in California and they encourage validation of these results in different populations.

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Commentary: Current TOR guidelines exist in many EMS organizations. With respect to Advanced Life Support (ALS) intervention, these guidelines call for resuscitation efforts to begin immediately and continue for up to 30 minutes. This study postulates that even those 30 minutes could pose unnecessary trauma to the patient and undue burden to the family, as well as EMS provider, for a futile outcome. Overall this is a well-done derivation of a potentially useful rule for OHCA futility. Validation is needed before this should be used to guide resuscitation policies or protocols.

☐ DID THIS PATIENT HAVE CARDIAC SYNCOPE? THE RATIONAL CLINICAL EXAMINATION SYSTEMATIC REVIEW.

Albassam OT, Redelmeier RJ, Shadowitz S, et al.
JAMA 2019;321:2448-2457

Syncope accounts for a large proportion of Emergency Department visits each year, with an overall incidence of 0.6% per year in adults and 2-6% in elderly patients. Cardiac syncope, which accounts for 5-21% of syncope presentations in primary care and emergency settings, is transient loss of consciousness due to a reduction in cardiac output secondary to cardiopulmonary disease (i.e., mechanical/structural heart disease or arrhythmias). Distinguishing cardiac syncope from other causes, such as reflex syncope or orthostatic syncope, can be challenging.

This systematic review sought to identify the reliability of patient demographics, precipitating factors, and reported symptoms in accurately identifying the category of underlying syncope. Paired investigators independently reviewed the literature from multiple publication databases. Included studies were published in English with ≥ 10 subjects of at least 12 years of age and had valid reference standards which included cardiology consultation, non-invasive cardiac evaluation and invasive cardiac evaluation. Exclusion criteria included studies concentrated on patients with recurrent syncope, single identifiable syncopal events and patients who had previously completed invasive cardiac testing. The paired investigators used the Quality Assessment of Diagnostic Accuracy Studies tool to independently determine the quality of the publications. Consensus opinion settled any disagreements and qualitative review by a third investigator reconciled cases without consensus. The level of evidence grading system developed for the Rational Clinical Examination series was used to assign studies as being level 1, level 2 or level 3 evidence while studies graded below level 3 were excluded. Authors calculated sensitivities, specificities, likelihood ratios and the associated confidence intervals for relevant history of present illness. They also examined the reliability of combinations of findings, features useful for distinguishing syncope from seizure, and usefulness of biomarkers in evaluation of syncope.

A total of 11 studies consisting of 4,317 patients were included with four level 1 studies, two level 2 studies and five level 3 studies. Of these, 6 studies included patients presenting to the emergency department, three were patients admitted for syncope and two involved inpatient and outpatient referrals for syncope. Cardiac syncope was diagnosed in 9-58% of cases for all studies. Of included patient demographics, age at first syncope of ≥ 35 years had the greatest sensitivity for cardiac syncope (sensitivity, 91% [95% CI, 85-97%]; specificity, 72% [95% CI, 66-78%]; likelihood ratio [LR], 3.3 [95% CI, 2.6-4.1] while atrial fibrillation/flutter had the greatest specificity (sensitivity 13% [95% CI, 6-20%]; specificity, 98% [95% CI, 96-100%); LR, 7.3 [95% CI, 2.4-22]). Both heart failure and severe structural heart disease were also highly associated with cardiac syncope, exhibiting specificities of 88-94% (LR 2.7-3.4) and 84-93% (LR 3.3-4.8), respectively. While both chest pain (range of specificity 0.95-0.98) and dyspnea (specificity 95%, [95% CI, 80-99%) prior to the syncopal event conferred higher likelihood of cardiac syncope, preceding palpitations had inconsistent correlation. Cyanosis during loss of consciousness was highly specific for cardiac syncope (sensitivity 8% [95% CI, 2-14%]; specificity, 99% [95% CI, 98-100%]; LR, 6.2 [95% CI, 1.6-24]. Although the absence of prodromal symptoms is classically associated with cardiac syncope, no association for higher or lower likelihood was exhibited. Preceding pallor and injury after the event also failed to confer higher or lower likelihood of cardiac syncope.

Cardiac syncope was less likely in cases of preceding mood changes, cold feeling, headache, and abdominal discomfort, as well as with mood changes after the event or amnesia to behavior preceding the syncopal event. Patients with normal EKG findings and no history of heart disease were less likely to have experienced cardiac syncope while those with one or both had increased likelihood (sensitivity 88% [95% CI, 82-94%]; specificity, 61% [95% CI, 51-71%]; LR, 0.20 [95% CI, 0.12-0.33]). The Evaluation of Guidelines in Syncope Study (EGSYS) score (range -2 to 12) was prospectively validated in 2 studies and cardiac syncope was more likely for an EGSYS score ≥ 3 (sensitivity 89-91%; specificity 69-73%; LR 0.12-0.17). A vasovagal score (range 14 to 6) did well in an initial level 3 study but failed validation in a subsequent study with combined data demonstrating a score less than -2 confers increased risk of cardiac syncope (n = 703; sensitivity 0.32-0.91%; specificity 0.81-0.89%; LR 1.7-8.6). A level 3 study also examined features to distinguish seizure versus syncope. Features most helpful for indicating syncope were prolonged sitting/standing (LR 20, [95% CI, 5.3-100]), dyspnea (LR 13 [95% CI,3.0-50]) and palpitations (LR 8.3 [95% CI,3.2-25]). This same study also showed cardiac disease conferred the greatest risk for cardiac syncope (LR 13 [95% CI, 3.2-50]). With regards to biomarkers, a specificity of 95% for cardiac syncope was seen with a high-sensitivity troponin T threshold of 42ng/L (LR, 5.1 [95% CI, 3.6-7.1]) and a high-sensitivity troponin I of 31.3ng/L (LR 5.4 [95% CI, 3.9-7.6]). Syncope was ruled out for high-sensitivity troponin T < 5ng/L (LR, 0.15 [95% CI, 0.08-0.31]) or high-sensitivity troponin I < 2.2 ng/L (LR, 0.18 [95% CI, 0.10-0.35]). A 95% specificity for cardiac syncope required an N-terminal pro-B-type natriuretic peptide (NT-proBNP) level > 1966pg/mL (LR, 5.8 [95% CI, 4.2-8.1]) while normal levels had low likelihood of cardiac etiology