# Journal Meeting

**Defibrillator charging before rhythm analysis significantly reduces hands-off time during resuscitation: a simulation study.**

American Journal of Emergency Medicine (2013) **31**, 395–400

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2013.3.12

# Introduction

- **Two pivotal importance of treating a patient in cardiac arrest.**
  - **High-Quality Chest compression**
  - **Rapid defibrillation**
- **Studies have shown that ANY INCREASE in hands-off time leads to significantly increased mortality.**

*Yu T et al. Adverse outcomes of interrupted precordial compression during automated defibrillation. Circulation 2002;106:368-72*

# Guideline told us ...

- 2010 International guidelines for resuscitation suggest interruptions in chest compression should be less than 5 sec. → **It's Hard !!!**

  *Koster RW et al. Part 5: adult basic life support: 2010 international consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Resuscitation 2010;81(Suppl. 1):e48-70*

- 2005 European Resuscitation Council (ERC) guideline:
  -- ALS provider keep hands off while charging defibrillator.
- 2010 ERC guideline :
  -- Keep hands off while rhythm check, keep compression while charging defibrillator, and remove for shock delivery.

# Author's hypothesis

- Hands-off time in the context of defibrillation can be reduced even further with simple means.
- This study using an alternative sequence for defibrillation of cardiac arrests could be reduced compared to both 2005 and 2010 ALS guideline.

# Methods

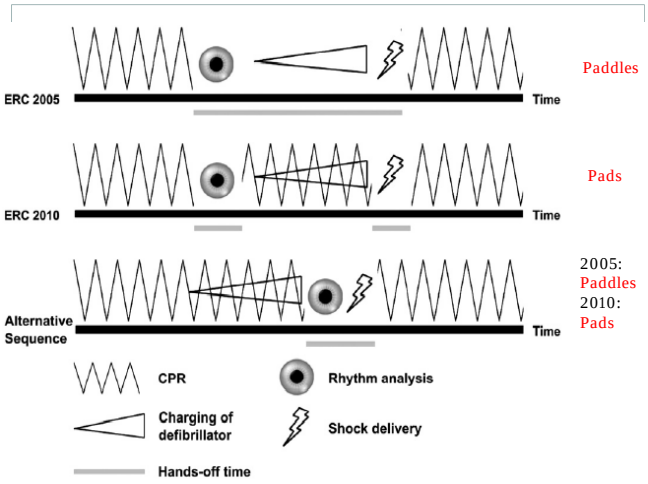
- Equipment : Resusci Anne HLR-D mannequin and Lifepak 12 and 20 defibrillators.
  -- unable to record data on the quality of chest compression.
- Participants
  -- On call junior physicians at regional Danish hospital
  -- All volunteers.

# Experiment

- Participant randomly assigned to preplanned scenarios by a 6-sided dice roll.
- All were confronted with both pulseless VT and asystole.
- Each experiment lasted until the participants had treated both pVT and asystole using either 2005 or 2010 guideline or alternative sequence according to randomization.

## Experiment

- Participant was set to be team leader and handle defibrillation.
- Start and stop of chest compressions and ventilation were handled on the order of team leader, and the stand-ins had no decisions.
- Screen was cover until the order to halt the chest compression by team leader.
- Hands-off time was recorded using a manual timer.




## Information about participants

**Table** Demographics/information about participants

| Participant specialty | Level of training | No. of CPRs | Years since graduation |
|---|---|---|---|
| ERC 2005 vs alternative sequence: | | | |
| 1 Medicine | Residency | 25 | 4 |
| 2 Medicine | Internship | 2 | 0 |
| 3 Medicine | Residency | 6 | 7 |
| 4 Medicine | Residency | 12 | 2 |
| 5 Medicine | Internship | 8 | 0 |
| 6 Medicine | Residency | 15 | 5 |
| 7 Medicine | Residency | 11 | 4 |
| 8 Medicine | Internship | 1 | 0 |
| 9 Anaesthesia | Specialist | 25 | 12 |
| 10 Cardiology | Residency | 10 | 5 |

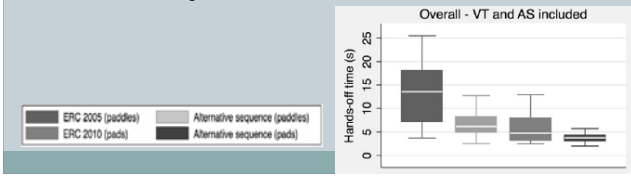
| ERC 2010 vs alternative sequence | | | |
|---|---|---|---|
| 1 Medicine | Residency | 2 | 2 |
| 2 Cardiology | Specialist | 100 | 24 |
| 3 Medicine | Residency | 10 | 16 |
| 4 Medicine | Residency | 20 | 1 |
| 5 Medicine | Internship | 0 | 0 |
| 6 Medicine | Residency | 1 | 2 |
| 7 Medicine | Internship | 3 | 0 |
| 8 Medicine | Residency | 20 | 3 |
| 9 Medicine | Internship | 0 | 0 |
| 10 Medicine | Residency | 20 | 3 |
| 11 Medicine | Residency | 50 | 1 |
| 12 Medicine | Residency | 25 | 1 |

## Results

- 2005 ERC guideline
  - -- overall mean hands-off time : 13.0 sec
  - -- alternative sequence : 6.7 sec

  P<0.01
- 2010 ERC guideline
  - -- overall mean hands-off time: 5.6 sec
  - -- alternative sequence : 3.9 sec

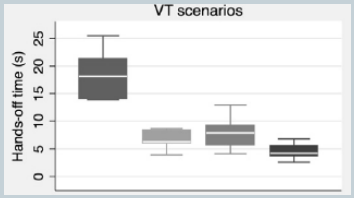
  P<0.01



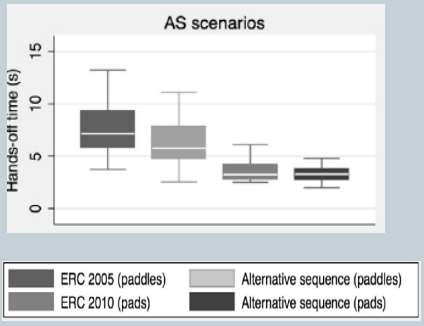

## If we look at pVT only...

- 2010 ERC guideline
  - -- overall mean hands-off time : 7.6 sec
  - -- Alternative sequence : 4.5 sec

  P<0.01




## No significant difference in asystole



## Discussions

- Only a small alteration could make a big change, we were able to reach hands-off time < 5 sec.
- Study showed even a brief pause in chest compression
  → perfusion pressure of the coronary and carotid arteries fell extremely.
- Our alternative sequence compared to
  -- 2005 ERC : 6.3 sec reduction
  -- 2010 ERC : 1.7 sec reduction

## Data from defibrillators showed us

- Most of the time, chest compression are often not resumed while charging.
- Rescuers often thought (1)unnecessary to resume chest compression for such a brief interval (2)afraid of being shocked accidentally.
  → Major objection to the alternative sequence.

## Potential increased risk of shocking ALS providers ?

- Limited experienced junior physicians with only brief introduction to alternative sequence.
  -- However, 88 rhythm checks in our study show no examples of potential dangerous defibrillations.
- Edelson et al analyzed 562 defibrillations only 1 shock was delivered while chest compression was ongoing.
  -- compression still continued at same rate, suggesting no harm was done.
- Recent studies indicates that chest compression can safely be continued during defibrillations.

## Paddle v.s. Pads

- Only when using pads and alternative sequence, we were able to have hands-off time <5 sec. ( 3.9sec)
- In the updated 2010, use of pads is encouraged, and it came close to 5 sec. ( 5.6 sec)
- And our alternative sequence have only 1 intermission compared to 2010 with 2 intermissions.

## Limitations

- A simulation study
  -- participants may be less cautious
  -- no normal chaos, noise, confusion
- Only focus on defibrillation itself
  -- not a full-scale simulation
- Old Anne
  -- unable to record the quality of chest compression and ventilation (limited findings)

## Limitations

- Manual timer
  -- inferior method compared to automatic registration by novel resuscitation Anne.
  -- potential measurement error in all sequences.
- We measured the interval from the participants asked for chest compression to be halted until they were asked to resume.
  -- potentially lead to significant effect of individual participants.

## Take home massage

- Charging of the defibrillator before rhythm analysis significantly reduced hands-off time compared with ERC 2005 and ERC 2010 guidelines.
- Pads is recommended for current defibrillation strategy.
- It's not that risky to have chest compression while defibrillation.

# Journal Meeting

**Red cell distribution width as a prognostic marker in patients with community-acquired pneumonia.**

American Journal of Emergency Medicine (2013) **31**, 72–79

Jae Hyuk Lee MD, PhD, Hea Jin Chung MD, Kyuseok Kim MD, PhD*, You Hwan Jo MD, PhD, Joong Eui Rhee MD, PhD, Yu Jin Kim MD, PhD, Kyeong Won Kang MD

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2013.3.12

## Introduction

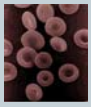
- Community-acquired pneumonia (CAP)
  - -- leading infectious cause of death
  - -- prognostication is important with management.
- Current prognostic scales
  - -- Pneumonia Severity Index (PSI)
    *Age, gender, comorbid disease, PE, Lab*
  - -- CURB-65
    *Confusion, Urea, RR, BP, Age≥65*

## Prognostic scales

- These scales are used to predict probability of mortality/morbidity among 30-day survival.
- **PSI**
  - -- Useful for identifying low-risk patient.
  - -- Could be safety managed as outpatient.
- **CURB-65**
  - -- Useful for identifying high-risk patient.
  - -- risk of death.
- Thus, we need add some more biomarkers to improve the prognostic performance.

## Red cell distribution width

- RDW - a coefficient of variation of circulating red cells.
  - -- reflect the heterogenicity of red cell volume
  - -- a component of CBC
  - -- limited to differential diagnosis of anemia



- Recently, reports associated elevated RDW with outcomes in :
  - Cardiovascular disease ; Rheumatoid arthritis
  - Colon cancer ; Metabolic syndrome
- We hypothesized that RDW would be associated with 30-day mortality and prognosis factor with CAP.

## Methods

- **Study design**
  - -- Retrospective analysis of a prospective registry database
  - -- 950-bed tertiary academic hospital
  - -- Annual ED census of 67,000
- **Participants**
  - -- visit ED, and hospitalized for CAP by attending physician of ED based on PSI scale and other medical conditions.
  - -- between April 2008 and March 2011.
  - -- All are older than 18yr

## Methods - Selection of participants

- CAP was defined as pulmonary infiltrate on CXR, and symptoms consistent with pneumonia , which were not acquired in hospital or nursing home.
- Also, CXR (X) initial, abnormal lung sound, f/u CXR (O) .

- Exclusion criterias
  - -- transfer, discharge from hospital within 10days, experience pneumonia within past 30days.
  - -- active TB, HIV(+),
  - -- chronic immunosuppressed ( organ transplant, post-splenectomy, >10mg/d prednisolone < 30 day, neutropenia)

## Methods - Data collection

- **Initial lab data at ED**
  - -- leukocyte count, Hb, Hct, MCV, MCH, RDW, plt
  - -- Glu, crea, BUN, albumin, T-chol, PT, aPTT, CRP.
  - -- PSI and CURB-65 while ED visit.

- Determine the status of patient 1 month after initial ED visit, ascertain death by medical record or by telephone after discharge.
  - -- 744 pt hospitalized , 702 pt identified by chart.
  - -- 42 pt telephone contact, 10 pt were transferred to other facility after acute management for CAP.

## Methods - Outcome measure

- **Primary end point**
  - -- 30 day mortality after the ED visit.
  - -- survival time was also investigated.

- **Secondary end point**
  - -- hospital length of stay
  - -- use of vasopressors
  - -- ICU admission
  - -- mechanical ventilator require

## Methods – Primary data analysis

- Impact of RDW on outcome of CAP patients
  - -- categorized into quartiles

| RDW | <13.3% | 13.3~14.1% | 14.1~15.2% | >15.2% |
|---|---|---|---|---|

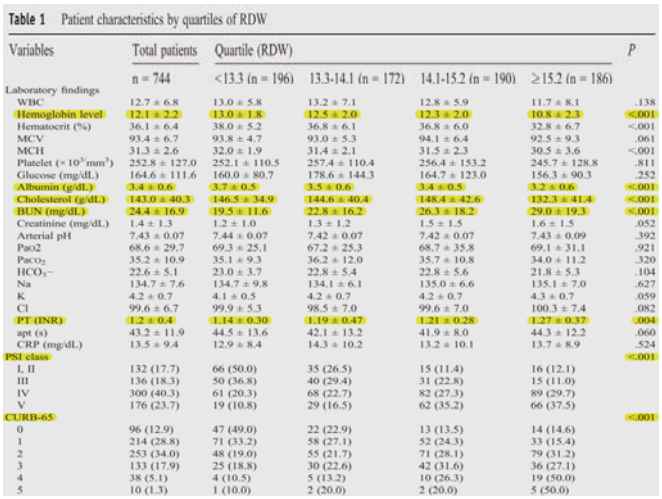
- Test of the added ability of RDW to predict 30-day mortality.

## Results – Characterisitcs

**Table 1** Patient characteristics by quartiles of RDW

| Variables | Total patients | Quartile (RDW) | | | | P |
|---|---|---|---|---|---|---|
| | n = 744 | <13.3 (n = 196) | 13.3-14.1 (n = 172) | 14.1-15.2 (n = 190) | ≥15.2 (n = 186) | |
| Age (mean ± SD) | 70.1 ± 15.0 | 65.2 ± 17.5 | 70.6 ± 14.3 | 73.1 ± 13.8 | 71.5 ± 12.7 | <.001 |
| Male sex (%) | 238 (32.0) | 62 (33.2) | 65 (37.8) | 58 (30.5) | 50 (26.9) | .159 |
| Comorbidities, n (%) | | | | | | |
| Heart failure | 18 (2.4) | 2 (1.0) | 2 (1.2) | 8 (4.2) | 6 (3.2) | .120 |
| Renal failure | 83 (11.2) | 16 (8.2) | 15 (8.7) | 24 (12.6) | 28 (15.1) | .113 |
| Liver disease | 44 (5.9) | 7 (3.6) | 11 (6.4) | 15 (7.9) | 11 (5.9) | .322 |
| COPD | 148 (19.9) | 38 (19.4) | 39 (22.7) | 38 (20.0) | 33 (17.7) | .704 |
| Neoplasm | 195 (26.2) | 35 (17.9) | 26 (15.1) | 55 (29.0) | 79 (42.5) | <.001 |
| Neurologic disease | 187 (25.1) | 42 (21.4) | 44 (25.6) | 56 (29.5) | 45 (24.2) | .331 |
| Diabetes mellitus | 222 (29.8) | 48 (24.5) | 50 (29.1) | 63 (33.2) | 61 (32.8) | .207 |

- Overall 30-day mortality :13.4%



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| Laboratory findings | | | | | | |
| WBC | 12.7 ± 6.8 | 13.0 ± 5.8 | 13.2 ± 7.1 | 12.8 ± 5.9 | 11.7 ± 8.1 | .138 |
| Hemoglobin level | 12.1 ± 2.2 | 13.0 ± 1.8 | 12.5 ± 2.0 | 12.3 ± 2.0 | 10.8 ± 2.3 | <.001 |
| Hematocrit (%) | 36.1 ± 6.4 | 38.0 ± 5.2 | 36.8 ± 6.1 | 36.8 ± 6.0 | 32.8 ± 6.7 | <.001 |
| MCV | 93.4 ± 6.7 | 93.8 ± 4.7 | 93.0 ± 5.3 | 94.1 ± 6.4 | 92.5 ± 9.3 | .061 |
| MCH | 31.3 ± 2.6 | 32.0 ± 1.9 | 31.4 ± 2.1 | 31.5 ± 2.3 | 30.5 ± 3.6 | <.001 |
| Platelet (× $10^3$/mm$^3$) | 252.8 ± 127.0 | 252.1 ± 110.5 | 257.4 ± 110.4 | 256.4 ± 153.2 | 245.7 ± 128.8 | .811 |
| Glucose (mg/dL) | 164.6 ± 111.6 | 160.0 ± 80.7 | 178.6 ± 144.3 | 164.7 ± 123.0 | 156.3 ± 90.3 | .252 |
| Albumin (g/dL) | 3.4 ± 0.6 | 3.7 ± 0.5 | 3.5 ± 0.6 | 3.4 ± 0.5 | 3.2 ± 0.6 | <.001 |
| Cholesterol (g/dL) | 143.0 ± 40.3 | 146.5 ± 34.9 | 144.6 ± 40.4 | 148.4 ± 42.6 | 132.3 ± 41.4 | <.001 |
| BUN (mg/dL) | 24.4 ± 16.9 | 19.5 ± 11.6 | 22.8 ± 16.2 | 26.3 ± 18.2 | 29.0 ± 19.3 | <.001 |
| Creatinine (mg/dL) | 1.4 ± 1.3 | 1.2 ± 1.0 | 1.3 ± 1.2 | 1.5 ± 1.5 | 1.6 ± 1.5 | .052 |
| Arterial pH | 7.43 ± 0.07 | 7.44 ± 0.07 | 7.42 ± 0.07 | 7.42 ± 0.07 | 7.43 ± 0.09 | .392 |
| Pao2 | 68.6 ± 29.7 | 69.3 ± 25.1 | 67.2 ± 25.3 | 68.7 ± 35.8 | 69.1 ± 31.1 | .921 |
| $Paco_2$ | 35.2 ± 10.9 | 35.1 ± 9.3 | 36.2 ± 12.0 | 35.7 ± 10.8 | 34.0 ± 11.2 | .320 |
| $HCO_3^-$ | 22.6 ± 5.1 | 23.0 ± 3.7 | 22.8 ± 5.4 | 22.8 ± 5.6 | 21.8 ± 5.3 | .104 |
| Na | 134.7 ± 7.6 | 134.7 ± 9.8 | 134.1 ± 6.1 | 135.0 ± 6.6 | 135.1 ± 7.0 | .627 |
| K | 4.2 ± 0.7 | 4.1 ± 0.5 | 4.2 ± 0.7 | 4.2 ± 0.7 | 4.3 ± 0.7 | .059 |
| Cl | 99.6 ± 6.7 | 99.9 ± 5.3 | 98.5 ± 7.0 | 99.6 ± 7.0 | 100.3 ± 7.4 | .082 |
| PT (INR) | 1.2 ± 0.4 | 1.14 ± 0.30 | 1.19 ± 0.47 | 1.21 ± 0.28 | 1.27 ± 0.37 | .004 |
| apt (s) | 43.2 ± 11.9 | 44.5 ± 13.6 | 42.1 ± 13.2 | 41.9 ± 8.0 | 44.3 ± 12.2 | .060 |
| CRP (mg/dL) | 13.5 ± 9.4 | 12.9 ± 8.4 | 14.3 ± 10.2 | 13.2 ± 10.1 | 13.7 ± 8.9 | .524 |
| PSI class | | | | | | <.001 |
| I, II | 132 (17.7) | 66 (50.0) | 35 (26.5) | 15 (11.4) | 16 (12.1) | |
| III | 136 (18.3) | 50 (36.8) | 40 (29.4) | 31 (22.8) | 15 (11.0) | |
| IV | 300 (40.3) | 61 (20.3) | 68 (22.7) | 82 (27.3) | 89 (29.7) | |
| V | 176 (23.7) | 19 (10.8) | 29 (16.5) | 62 (35.2) | 66 (37.5) | |
| CURB-65 | | | | | | <.001 |
| 0 | 96 (12.9) | 47 (49.0) | 22 (22.9) | 13 (13.5) | 14 (14.6) | |
| 1 | 214 (28.8) | 71 (33.2) | 58 (27.1) | 52 (24.3) | 33 (15.4) | |
| 2 | 253 (34.0) | 48 (19.0) | 55 (21.7) | 71 (28.1) | 79 (31.2) | |
| 3 | 133 (17.9) | 25 (18.8) | 30 (22.6) | 42 (31.6) | 36 (27.1) | |
| 4 | 38 (5.1) | 4 (10.5) | 5 (13.2) | 10 (26.3) | 19 (50.0) | |
| 5 | 10 (1.3) | 1 (10.0) | 2 (20.0) | 2 (20.0) | 5 (50.0) | |

# Results

- Independent risk factors associated with 30-day mortality.

**Table 2** Multivariate logistic regression analysis

| Variables | Odds ratio (95% CI) | *P* |
|---|---|---|
| RDW <13.3 | Reference | |
| RDW 13.3-14.1 | 0.73 (0.28-1.91) | .518 |
| RDW 14.1-15.2 | 1.11 (0.47-2.62) | .815 |
| RDW ≥15.2 | 2.37 (1.04-5.42) | .040 |
| PSI class I, II | Reference | |
| PSI class III | 1.47 (0.24-8.93) | .678 |
| PSI class IV | 4.76 (1.01-22.53) | .049 |
| PSI class V | 7.10 (1.42-35.42) | .017 |
| CURB-65 | | |
| 0 | Reference | |
| 1 | 1.34 (0.25-7.20) | .730 |
| 2 | 2.26 (0.45-11.30) | .323 |
| 3 | 2.44 (0.46-12.82) | .292 |
| 4 | 3.42 (0.58-20.06) | .174 |
| 5 | 37.02 (2.49-550.32) | .009 |
| Hematocrit | 1.03 (0.99-1.07) | .191 |
| MCH | 1.01 (0.92-1.10) | .869 |
| Albumin | 0.19 (0.11-0.33) | <.001 |
| Cholesterol | 1.01 (1.00-1.01) | .073 |
| Prothrombin time | 1.14 (0.57-2.26) | .716 |

# Results- effect of each quartile of RDW

**Table 3** Community-acquired pneumonia outcomes stratified by RDW

| Variables | Total patients (n = 744) | Quartile (RDW) | | | | *P* |
|---|---|---|---|---|---|---|
| | | Quartile 1 (RDW <13.3, n = 196) | Quartile 2 (13.3 ≤ RDW < 14.1, n = 172) | Quartile 3 (14.1 ≤ RDW < 15.2, n = 190) | Quartile 4 (RDW ≥ 15.2, n = 186) | |
| 30-d mortality, n (%) | 100 (13.4) | 11 (5.6) | 12 (7.0) | 24 (12.6) | 53 (28.5) | <.001 |
| PSI | | | | | | |
| I, II | 2/132 (1.5%) | 0/66 (0.0%) | 0/35 (0.0%) | 0/15 (0.0%) | 2/16 (12.5%) | .026 |
| III | 4/136 (2.9%) | 1/50 (2.0%) | 1/40 (2.5%) | 1/31 (3.2%) | 1/15 (6.7%) | .730 |
| IV | 41/300 (13.7) | 6/61 (9.8%) | 4/68 (5.9%) | 10/82 (12.2%) | 21/89 (23.6%) | .011 |
| V | 53/176 (30.1) | 4/19 (21.1%) | 7/29 (24.1%) | 13/62 (21.0%) | 29/66 (43.9%) | .026 |
| CURB-65 | | | | | | |
| 0 | 2/96 (2.1%) | 1/47 (2.1%) | 0/22 (0.0%) | 1/13 (7.7%) | 0/14 (0.0%) | .392 |
| 1 | 11/214 (5.1%) | 0/71 (0.0%) | 3/58 (5.2%) | 3/52 (5.8%) | 5/33 (15.2%) | .006 |
| 2 | 36/253 (14.2%) | 4/48 (8.3%) | 2/55 (3.6%) | 7/71 (9.9%) | 23/79 (29.1%) | <.001 |
| 3 | 27/133 (20.3%) | 4/25 (16.0%) | 3/30 (10.0%) | 10/42 (23.8%) | 10/36 (27.8%) | .282 |
| 4 | 16/38 (42.1%) | 1/4 (25.0%) | 2/5 (40.0%) | 2/10 (20.0%) | 11/19 (57.9%) | .237 |
| 5 | 8/10 (80%) | 1/1 (100.0%) | 2/2 (100.0%) | 1/2 (50.0%) | 4/5 (80.0%) | 1.000 |
| Secondary outcomes | | | | | | |
| HLOS, median (IQR) | 11 (7-18) | 10 (6-15) | 11 (8-17.5) | 11.5 (8-21) | 12 (8-20) | .004 |
| ICU admission, n (%) | 107 (14.4) | 18 (9.2) | 28 (16.3) | 29 (15.3) | 32 (17.2) | .075 |
| Vasopressor use, n (%) | 103 (13.8) | 10 (5.1) | 23 (13.4) | 32 (16.8) | 38 (20.4) | <.001 |
| MV use, n (%) | 102 (13.7) | 17 (8.7) | 25 (14.5) | 28 (14.7) | 32 (17.2) | .080 |

# Results – survival curve of quartile RDW

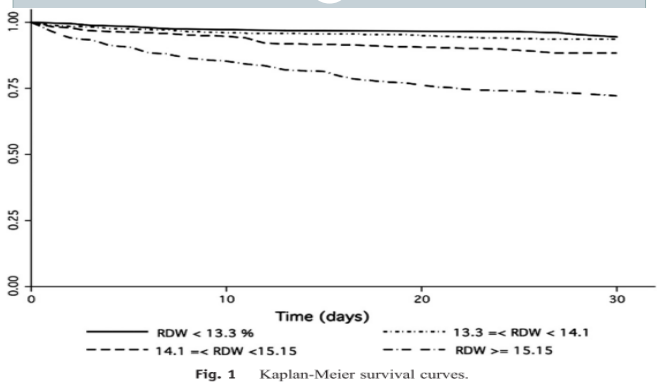



**Fig. 1** Kaplan-Meier survival curves.

# Results – Cox proportional hazard regression analysis

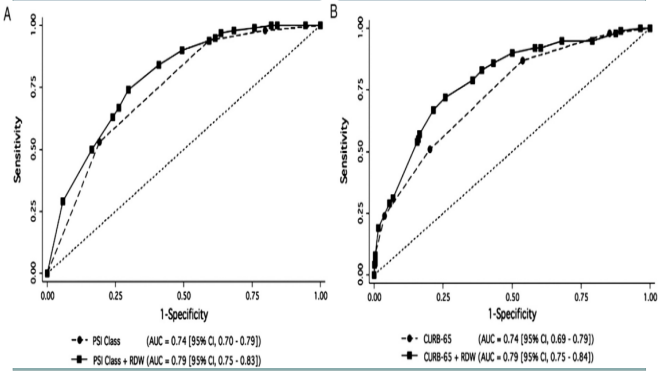
- Evaluate the relation between RDW and outcomes while adjusting for age, sex, PSI and other risk factors.

**Table 4** Hazard ratios by categories of RDW

| Model | Hazard ratio (95% CI) | | | | Test for trend *P* value |
|---|---|---|---|---|---|
| | RDW quartile 1 | RDW quartile 2 | RDW quartile 3 | RDW quartile 4 | |
| Model 1 | 1.0 (reference) | 0.86 (0.36-2.05) | 1.28 (0.59-2.74) | 2.31 (1.12-4.79) | <.001 |
| Model 2 | 1.0 (reference) | 0.76 (0.32-1.81) | 1.06 (0.49-2.28) | 2.06 (1.01-4.20) | <.001 |
| Model 3 | 1.0 (reference) | 0.88 (0.37-2.08) | 1.37 (0.64-2.95) | 2.45 (1.20-4.98) | <.001 |

Model 1 is adjusted for age, sex, neoplastic disease, hematocrit, albumin, cholesterol, BUN, and prothrombin time. Model 2 is adjusted for PSI, albumin, cholesterol, and prothrombin time. Model 3 is adjusted for CURB-65, albumin, cholesterol, and prothrombin time.

# Results – Add RDW to current scales




# Limitations

- Single institution and only included patient hospitalized via the ED.
- No gather data about anemia, transfusion status, or nutritional deficiency.
- ED physician knew the results of the lab values, including RDW, before enrollment.

## Discussions

- This study demonstrate higher RDW associated with increased 30-day mortality in CAP patient, especially in RDW >15.2%.
- Length of hospital stay and vasopressor require were also affected by RDW ↑ .
- Exact mechanism ?

## Currently we knew ...

- Suggest "inflammation" and "oxidative stress" affect red cell homeostasis.
- Studies showed RDW have a strong association with inflammatory biomarkers in general outpatient.
- Serum antioxidant level (selenium, carotenoids) have association with RDW in older women.
- However, CRP level were not different across the quartile change of RDW → CRP-insensitive inflammatory mechanism

## Role of albumin

- Among other variables, albumin was significant correlated with RDW, and was identify as an independent predictor of mortality in multi-analysis.
- Thus, low serum albumin level in high RDW patient may reflect the severity of CAP.
- In Future, while revise for the severity scale, may consider adding these biomarkers.

Thank you for your listening !