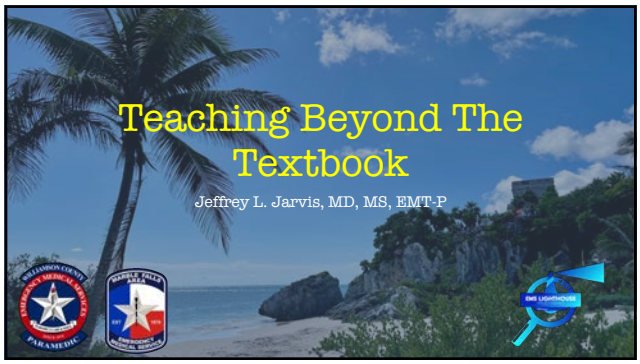
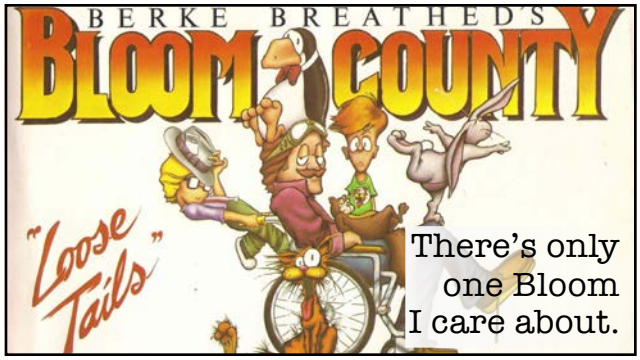

Teaching Beyond The Textbook
Jeffrey L. Jarvis, MD, MS, EMT-P

1


BERKE BREATHED'S
BLOOM COUNTY
"Loose Tails"
There's only one Bloom I care about.

2


Only the highest of tech solutions work for comms.
@BenAbo

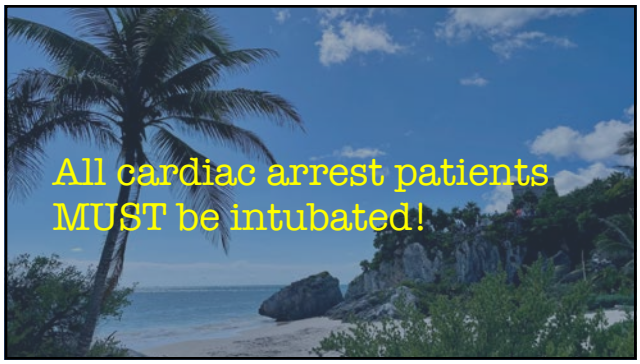
3


If we don't fully immobilize the patient, they'll pith themselves

4


NAEMSP Joint Statement 2018
• LSB does not "immobilize"
• SMR can be done with cots, scoops, vacuum splints
• NO indication for SMR in penetrating trauma
• Use NEXUS Criteria:
• AMS
• Midline pain
• Focal deficit
• Deformity
• Distracting Injury
• Age alone is NOT in indication for SMR

5


All cardiac arrest patients MUST be intubated!

6

PART: Pragmatic Airway Resuscitation Trial

	King LT	ETI	Difference
RT <= 4 min	28.3%	21.7%	*p < 0.001
FPS	90.3%	51.6%	
Unsuccessful with 1st Strategy	11.8%	44.1%	-32.4% (-35.6% to -29.1%)
Unrecognized/ Displaced Placement	0.7%	1.8%	-1.1% (-2.0% to -0.3%)
Airway swelling	1.1%	1.0%	NS

Wang HE, Schmicker RH, Daya MR, et A. Effect of a strategy of initial laryngeal tube insertion vs endotracheal intubation on 72-hour survival in adults with out-of-hospital cardiac arrest: A randomized clinical trial. JAMA. 2018/08/28; 320: 769-778.

7

PART: Pragmatic Airway Resuscitation Trial

	King LT	ETI	Difference
72-hour survival – ITT	***18.3%***	***15.4%***	***2.9% (0.2% - 5.6%)***
--- adjusted ITT			2.1% (-0.5% to 4.8%)
-- per-protocol			2.3% (-0.4% to 5.1%)
Time to 1st AAM	9.8 min	12.5 min	
Changed to ETI in ED	64.4%	33.1%	??? WTF ???

Wang HE, Schmicker RH, Daya MR, et A. Effect of a strategy of initial laryngeal tube insertion vs endotracheal intubation on 72-hour survival in adults with out-of-hospital cardiac arrest: A randomized clinical trial. JAMA. 2018/08/28; 320: 769-778.

8

AIRWAYS-2

	ETI	iGel	Difference
N	4,886	4,410	
Success w/ 2 attempts	79%	87.4%	aOR 1.9 (1.7 to 2.2)
Regurgitation during/after	13%	18%	NS
Aspiration during/after	7%	10%	NS
Airway Loss	5%	10.6%	aOR 2.3 (1.9 to 2.8)

Benger JR, Kirby K, Black S, et al. Effect of a strategy of a supraglottic airway device vs tracheal intubation during out-of-hospital cardiac arrest on functional outcome: The airways-2 randomized clinical trial. *JAMA*. 2018;320(8):779-791

9

AIRWAYS-2

	iGel	ETI	Difference	aOR (CI)
ROSC @ ED	30.6	28.4%	2.2% (0.3% to 4.2%)	1.12 (1.0 to 1.2)
Functional Survival ITT	6.4%	6.8%	-0.6% (-1.6% to 0.4%)	0.92(0.77 to 1.09))
Among Only those receiving any AAM				
Functional Survival ITT	3.9%	2.6%	1.4% (-0.5% to 2.2%)	1.6 (1.2 to 2.1)

Minimal Clinically Important Difference = 2%

Benger JR, Kirby K, Black S, et al. Effect of a strategy of a supraglottic airway device vs tracheal intubation during out-of-hospital cardiac arrest on functional outcome: The airways-2 randomized clinical trial. *JAMA*. 2018;320(8):779-791

10

- …BVM, SGA, or ETI may be considered for airway management in OHCA.
- Airway management should not interfere with key resuscitation interventions.
- Avoid hyperventilation

Carlson JN, Colella MR, Daya MR, et al. Prehospital Cardiac Arrest Airway Management. An NAEMSP Position Statement and Resource Document. *PEC*. 2022;26(supl):54-63.

11

If the tube is in the right place, it doesn't matter how many attempts it took

12

FPS Matters

- 1,823 ETI ED attempts
- Adverse Events:
- 1st Attempt: 14.2%
- 2nd Attempt: 47.2%
- 3rd Attempt: 63.6%

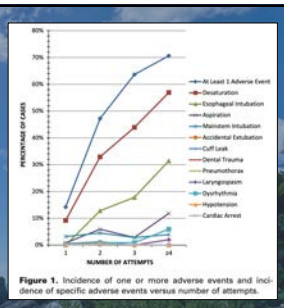


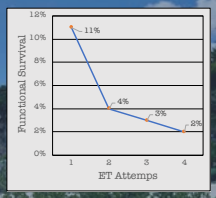
Figure 1. Incidence of one or more adverse events and incidence of specific adverse events versus number of attempts.

Sakles JC, Chiu S, Mosier J, Walker C, Stolz U. The importance of first pass success when performing orotracheal intubation in the emergency department. Acad Emerg Med 2013

13

Survival Drops With Each Additional ETI attempt

- Seattle FD observational study: 2015 – 2019
- 1,205 patients
- All cause OHCA – DL only
- FPS 63%
- 59% decreased survival with each additional attempt



Murphy DL, Bulger NE, Harrington BM et al. Fewer Tracheal Intubation Attempts Are Associated with Improved Neurologically Intact Survival Following Out-of-Hospital Cardiac Arrest. Resuscitation 2021;

14

DL is all I ever needed. VL is only for young weak wimps…

15

Methods	Secondary analysis of NEAR
Population	25 Academic EDs >14, intubated b/w 2016-2017
Intervention	Unassisted video laryngoscopy
Comparison	Augmented direct laryngoscopy • DL + bougie • DL + ramped position • DL + ELM
Outcome	1)FPS 2)Adverse events

Brown CA, et al. Video Laryngoscopy Compared to Augmented Direct Laryngoscopy in Adult Emergency Department Tracheal Intubations: A National Emergency Airway Registry (NEAR) Study. Acad Emerg Med 2020; 27(2), 100-108.

16

VL beats DL

	VL	aDL
FPS	90.9% (88.7% - 93.1%)	81.1% (78,7% - 83.5%)

	aOR (95%CI)
VL vs aDL	2.8 (2.4 – 3.3)
HA-VL vs aDL	3.2 (2.6 – 3.9)
SG-VL vs aDL	2.4 (1.9 – 3.0)

Brown CA, et al. Video Laryngoscopy Compared to Augmented Direct Laryngoscopy in Adult Emergency Department Tracheal Intubations: A National Emergency Airway Registry (NEAR) Study. Acad Emerg Med 2020; 27(2), 100-108.

17

VL Has Higher FPS in Trauma

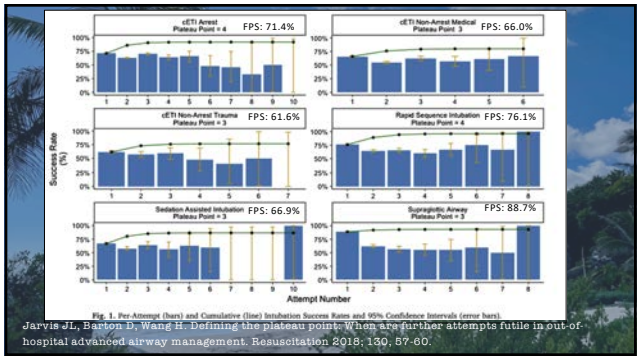
- Observational study of Level I Trauma Center
- 164 trauma activations
  - DL (41.5%) vs VL (58.5%) between 2016 – 2019
- FPS: DL (63.2%) vs VL (79.2%)
  - OR 2.28 (1.04 – 4.98)
- No *statistical* difference in peri-intubation hypoxia
  - DL 13.2% vs VL 7.3%, p = .172

Li T, Jafari D, Meyer C et al. Video laryngoscopy is associated with improved first-pass intubation success compared with direct laryngoscopy in emergency department trauma patients. JACEP Open 2021

18

RSI is complicated and dangerous.

19

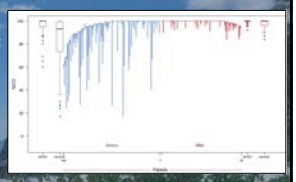


Jarvis JL, Barton D, Wang H. Defining the plateau point: When are further attempts futile in out-of-hospital advanced airway management. Resuscitation 2018; 130, 57-60.

20

Pre-Ox Decreases Peri-Intubation Hypoxia

- Peri-intubation hypoxia is common: 44% of EMS RSIs
- 2-3% of RSI: peri-intubation cardiac arrest
  - Vast majority from hypoxia
- It's avoidable with a bundle of care:
  - Positioning
  - PEEP
  - NIPPV w/ seal
  - ApOx
  - DSI
  - Goal-directed SpO2

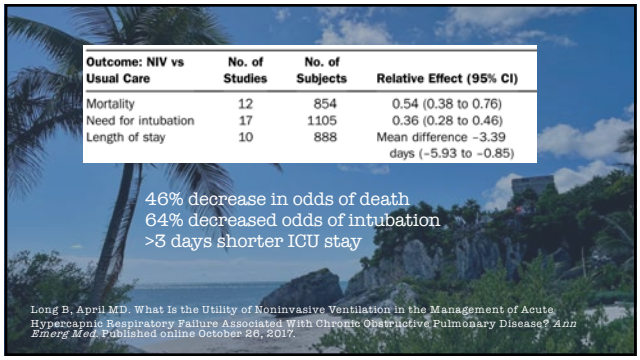


Jarvis JL, Gonzalez J, Johns D, Sager L. Implementation of a Clinical Bundle to Reduce Out-of-Hospital Peri-intubation Hypoxia. Annals of Emergency Medicine 2018

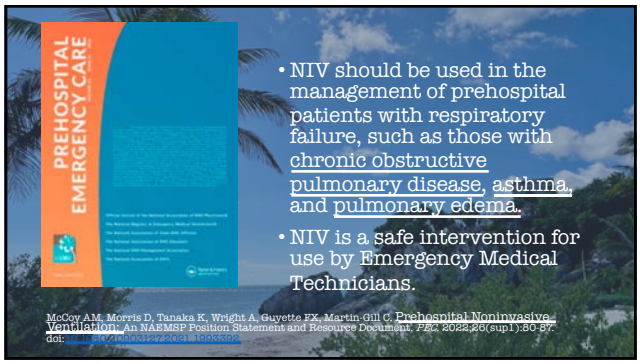
21


CPAP will explode lungs in patients with COPD!

22


Outcome: NIV vs Usual Care | No. of Studies | No. of Subjects | Relative Effect (95% CI)
Mortality | 12 | 854 | 0.54 (0.38 to 0.76)
Need for intubation | 17 | 1105 | 0.36 (0.28 to 0.46)
Length of stay | 10 | 888 | Mean difference −3.39 days (−5.93 to −0.85)
46% decrease in odds of death
64% decreased odds of intubation
>3 days shorter ICU stay
Long B, April MD. What Is the Utility of Noninvasive Ventilation in the Management of Acute Hypercapnic Respiratory Failure Associated With Chronic Obstructive Pulmonary Disease? Ann Emerg Med. Published online October 26, 2017.

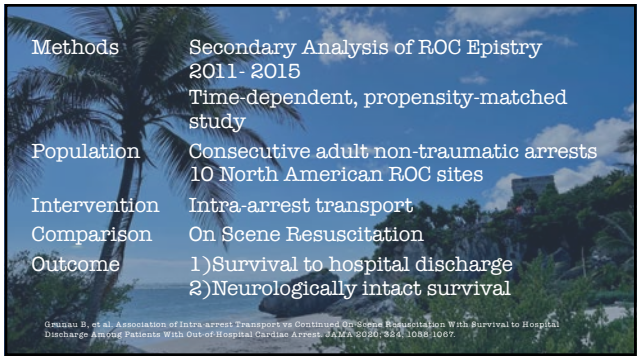
23


PREHOSPITAL EMERGENCY CARE
• NIV should be used in the management of prehospital patients with respiratory failure, such as those with chronic obstructive pulmonary disease, asthma, and pulmonary edema.
• NIV is a safe intervention for use by Emergency Medical Technicians.
McCoy AM, Morris D, Tanaka K, Wright A, Guyette FX, Martin-Gill C. Prehospital Noninvasive Ventilation: An NAEMSP Position Statement and Resource Document. PEC. 2022;2(sup1):80-87.

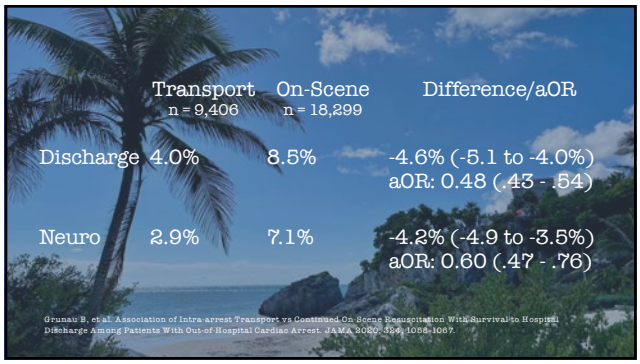
24


The Cure for Cardiac Arrest
is Diesel

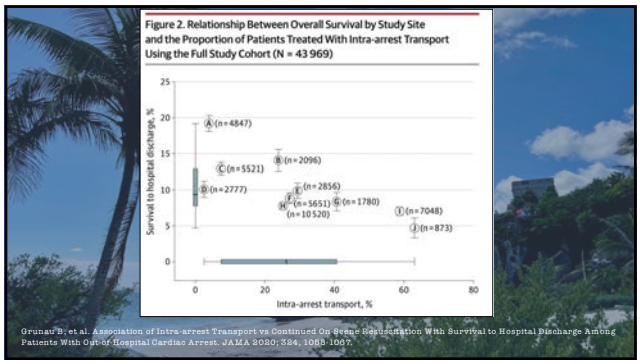
25


Methods
Secondary Analysis of ROC Epistry 2011- 2015
Time-dependent, propensity-matched study
Population
Consecutive adult non-traumatic arrests
10 North American ROC sites
Intervention
Intra-arrest transport
Comparison
On Scene Resuscitation
Outcome
1)Survival to hospital discharge
2)Neurologically intact survival
Grunau B, et al. Association of Intra-arrest Transport vs Continued On-Scene Resuscitation With Survival to Hospital Discharge Among Patients With Out-of-Hospital Cardiac Arrest. JAMA 2020; 324: 1058-1067.

26

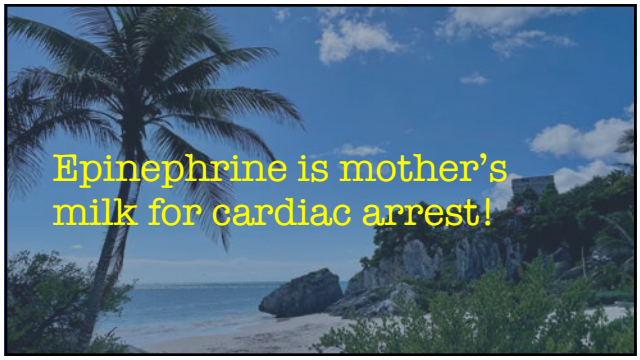

Transport
n = 9,406
On-Scene
n = 18,299
Difference/aOR
Discharge 4.0% 8.5% -4.6% (-5.1 to -4.0%)
aOR: 0.48 (.43 - .54)
Neuro 2.9% 7.1% -4.2% (-4.9 to -3.5%)
aOR: 0.60 (.47 - .76)
Grunau B, et al. Association of Intra-arrest Transport vs Continued On-Scene Resuscitation With Survival to Hospital Discharge Among Patients With Out-of-Hospital Cardiac Arrest. JAMA 2020; 324: 1058-1067.

27



Grunau B, et al. Association of Intra-arrest Transport vs Continued On-Scene Resuscitation With Survival to Hospital Discharge Among Patients With Out-of-Hospital Cardiac Arrest. JAMA 2020; 324, 1058-1067.

28



29

Outcome	Epi n = 4,015	Placebo n = 3,999	aOR (95%CI)
30-day survival	**3.2%**	**2.4%**	**1.47 (1.09-1.97)**
Survival to Hospital Admission	23.8%	8.0%	3.83 (3.30-4.43)
Survival to Hospital Discharge	3.2%	2.3%	1.48 (1.10-2.00)
Good Neuro Status at 90 days	2.1%	1.6%	1.39 (0.97-2.01)

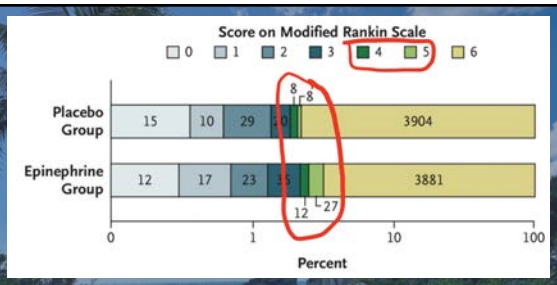
Perkins GD, Ji C, Deakin CD et al. A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest. N Engl J Med. 2018 Jul 18;

30

PARAMEDIC-2

Findings	Improved 30-day survival (3.2% vs 2.4%)
	No difference in neuro survival (2.2% v 1.9%)
	More devastation in survivors (31.0% vs 17.8%)
	0.2% probability of at least 2% improved survival
	0.0% probability of at least 2% improved neuro survival
	Minimum Clinically Important Difference = 5%
NNT	112 (30-day survival)
	11 (early recognition
	15 (bystander CPR)
	5 (early defib)
BUT…	999 to 1st epi: median 21 minutes

31



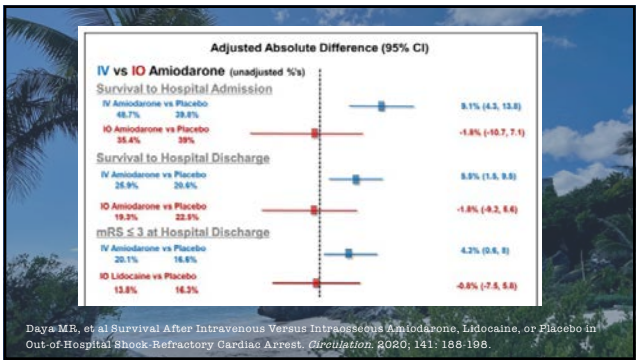
Severe Neurologic Disability Among Survivors	Epi 31.0%	Placebo 17.8%	OR 1.74

Perkins GD, Ji C, Deakin CD et al. A Randomized Trial of Epinephrine in Out-of-Hospital Cardiac Arrest. N Engl J Med. 2018 Jul 18;

32

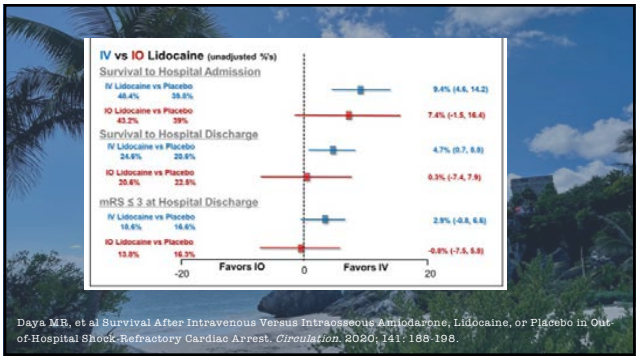
IOs are easy and worked just as well as IVs.

33



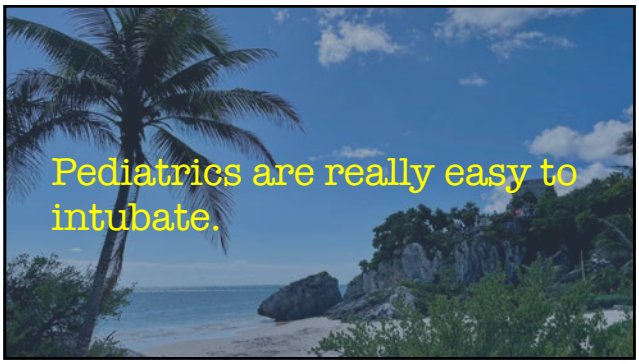
Daya MR, et al Survival After Intravenous Versus Intraosseous Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Shock-Refractory Cardiac Arrest. *Circulation*. 2020; 141: 188-198.

34



Daya MR, et al Survival After Intravenous Versus Intraosseous Amiodarone, Lidocaine, or Placebo in Out-of-Hospital Shock-Refractory Cardiac Arrest. *Circulation*. 2020; 141: 188-198.

35



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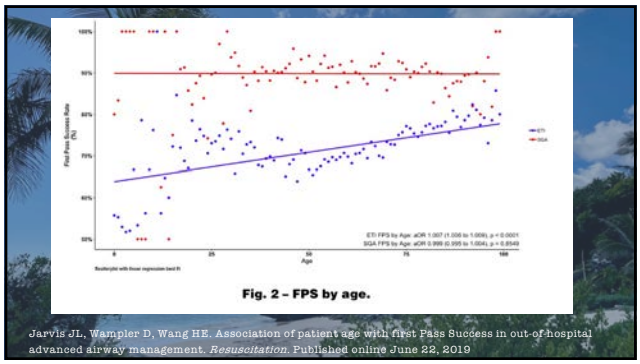


Fig. 2 – FPS by age.

Jarvis JL, Wampler D, Wang HE. Association of patient age with first Pass Success in out-of-hospital advanced airway management. *Resuscitation*. Published online June 22, 2019

37

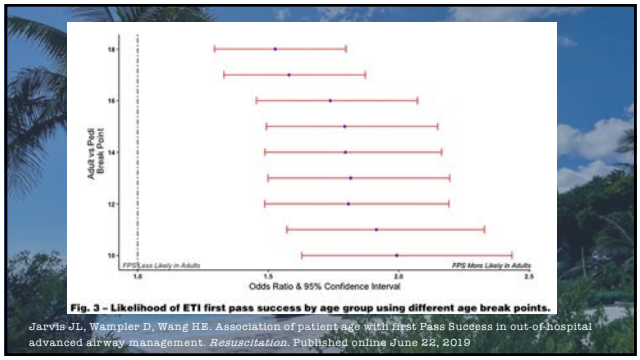


Fig. 3 – Likelihood of ETI first pass success by age group using different age break points.

Jarvis JL, Wampler D, Wang HE. Association of patient age with first Pass Success in out-of-hospital advanced airway management. *Resuscitation*. Published online June 22, 2019

38

Lights & Siren response is mandatory because lives are saved all the time!

39

- Massive dataset (>7.5 million EMS calls)
- RLS response to scene common (86%)
- RLS transport less common (13%)
- pLSI at any time rare (7%)
- RLS response can likely be safely targeted to call nature.

- Threshold Examples:
  - 5% -> 47% RLS Reduction
  - 10% -> 62% RLS Reduction

Jarvis JL, Hamilton Y, Taigman M, Brown LH. Using Red Lights and Sirens for Emergency Ambulance Response: How Often Are Potentially Life-Saving Interventions Performed. Prehosp Emerg Care 2020; 1-7.

40

Rocuronium is a potent sedative.

41

AIRWAY/ORIGINAL RESEARCH

The ED-AWARENESS Study: A Prospective, Observational Cohort Study of Awareness With Paralysis in Mechanically Ventilated Patients Admitted From the Emergency Department

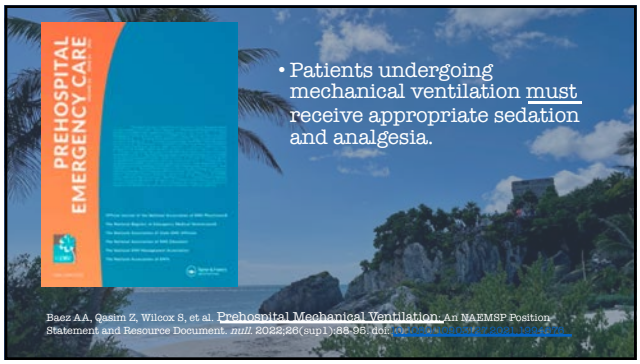
Ryan D. Pappal, BS, NRP; Brian W. Roberts, MD, MSc; Nicholas M. Mohr, MD, MS; Enjo Abiordeppey, MD, MPH; Brian T. Wessman, MD; Anne M. Drewry, MD; Winston Winkler, BS; Yan Yan, PhD; Marin H. Kollef, MD; Michael S. Avidan, MBBCh; Brian M. Fuller, MD, MSCI

- 2.6% of ED RSIs were aware of intubation – inadequately sedated
- OR for Awareness when given ROC vs not: 5.1 (1.3 – 20.1)
- Awareness a/w perceived threat, a risk factor for depression, anxiety, and PTSD

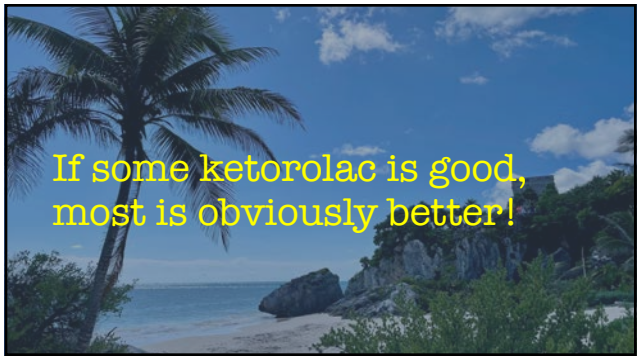
Bottom line: Protocolize the use of analgesia & sedation during and after intubation, especially with long-acting paralysis!

Pappal RD, Roberts BW, Mohr NM, et al. The ED-AWARENESS Study: A Prospective, Observational Cohort Study of Awareness With Paralysis in Mechanically Ventilated Patients Admitted From the Emergency Department. *Ann Emerg Med*. 2021;77(5):532-544.

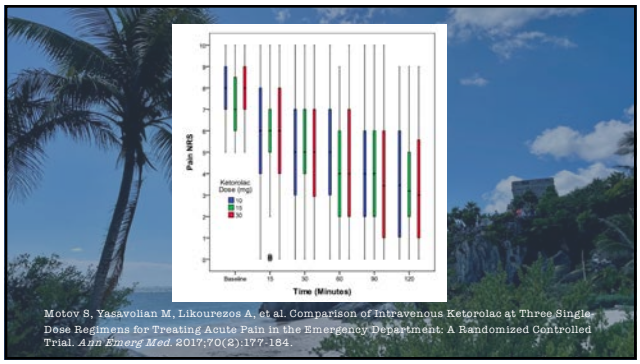
42


PREHOSPITAL EMERGENCY CARE
• Patients undergoing mechanical ventilation must receive appropriate sedation and analgesia.
Baez AA, Qasim Z, Wilcox S, et al. Prehospital Mechanical Ventilation: An NAEMSP Position Statement and Resource Document. null. 2022;26(sup1):88-95. doi:

43


If some ketorolac is good, most is obviously better!

44


Pain NRS
Ketorolac Dose (mg)
10
15
30
Baseline
15
30
60
90
120
Time (Minutes)
Motov S, Yasavolian M, Likourezos A, et al. Comparison of Intravenous Ketorolac at Three Single-Dose Regimens for Treating Acute Pain in the Emergency Department: A Randomized Controlled Trial. Ann Emerg Med. 2017;70(2):177-184.

45

Ketamine is given willy-nilly at the order of police officers to unmonitored patients solely to facilitate arresting them.

46

Ketamine in EMS

- 15,204 doses for 11,291 patients by 458 agencies.
- 14,734 (99.4%) transported to hospital
- 2,030 (18.0%) had HDE outcomes
- Mortality 128 (6.4%), 8 on-scene
- 2 (0.02%) deaths could not have ketamine excluded as cause of death
- 95% had SpO2
- 68% had EtCO2
- 23% of Behavioral had respiratory depression (EtCO2 > 45)

EMS Indication Category					
Trauma/Pain (n = 5,575)	Altered Mental Status /Behavioral (n = 3,795)	Cardiovascular/ Pulmonary (n = 1,454)	Seizure (n = 248)	Other (n = 219)
(49.4%)	(33.6%)	(12.9%)	(2.2%)	(1.9%)

Fernandez AR, Bourn SS, Crowe RP et al. Out-of-Hospital Ketamine: Indications for Use, Patient Outcomes, and Associated Mortality. Annals of Emergency Medicine 2021.

47

My takeaway

- Largest characterization of ketamine use by EMS
- NOT being used to facilitate arrests/jail
- Most common use is for pain
- Very rarely giving massive doses (<1%)
- Death is very rarely even vaguely attributable
- 95% being monitored with SpO2
- NOT full-proof
  - 8% hypoxia, 17% hypercapnia
  - 33% w/o EtCO2 monitoring
- Get our house in order: Mandatory SpO2 & EtCO2 monitoring

Fernandez AR, Bourn SS, Crowe RP et al. Out-of-Hospital Ketamine: Indications for Use, Patient Outcomes, and Associated Mortality. Annals of Emergency Medicine 2021.

48

RACKED Trial
(rapid agitation control with ketamine in the ED)

- Single ED RCT
- Undifferentiated Agitation (RASS >3)
- Ketamine 4mg/kg IM vs Haloperidol 5 mg + Midazolam 5mg IM
- Outcome: Time to Control (RASS <1)

Barbić D, Andolfatto G, Grunau B et al.Honer WG. Rapid Agitation Control With Ketamine in the Emergency Department: A Blinded, Randomized Controlled Trial. Annals of Emergency Medicine 2021;

49

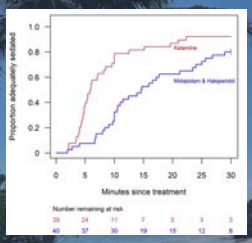
RACKED Trial

	Ketamine 4 mg/kg n = 40	Haloperidol 5mg + Midazolam 5 mg n = 40	
Time to sedation (RASS < -1)	14.7 min	5.8 min	8.8 min (3 – 15 min)
Hazard Ratio for Ketamine having faster sedation			2.43 (1.43 – 4.12)
Serious Adverse Events	12.5%	5.0%	7.5% (-4.8% to 19.8%)
Needing Intubation	0	0	0

Barbić D, Andolfatto G, Grunau B et al.Honer WG. Rapid Agitation Control With Ketamine in the Emergency Department: A Blinded, Randomized Controlled Trial. Annals of Emergency Medicine 2021;

50

RACKED Trial
(rapid agitation control with ketamine in the ED)



Barbić D, Andolfatto G, Grunau B et al.Honer WG. Rapid Agitation Control With Ketamine in the Emergency Department: A Blinded, Randomized Controlled Trial. Annals of Emergency Medicine 2021;

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Colometric EtCO2 is all we really need and waveform EtCO2 is unreliable in cardiac arrest.

Grmec S. Comparison of three different methods to confirm tracheal tube placement in emergency intubation. *Intensive Care Med.* 2002;28(6):701-704.

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Waveform capnography is unreliable in cardiac arrest

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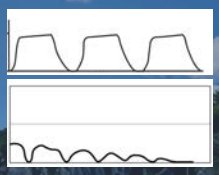
Use Waveform Capnography.

- 100% sensitivity/specificity
- Avoids esophageal intubations w/ 4 phase waveform
- Confirmation & monitoring



Silvestri S, Ladde JG, Brown JF et al. Endotracheal tube placement confirmation: 100% sensitivity and specificity with sustained four-phase capnographic waveforms in a cadaveric experimental model. Resuscitation 2017

Silvestri S, Ralls GA, Krauss B et al. The effectiveness of out-of-hospital use of continuous end-tidal carbon dioxide monitoring on the rate of unrecognized misplaced intubation within a regional emergency medical services system. Ann Emerg Med 2005

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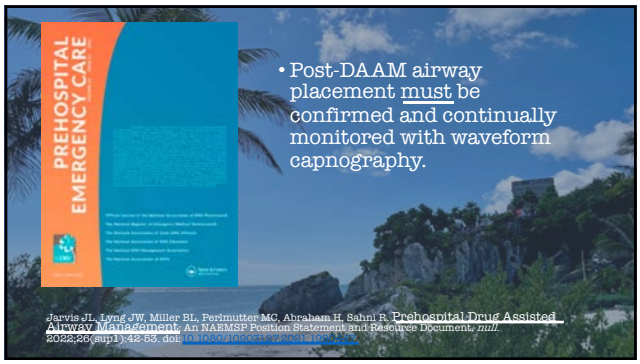
PREHOSPITAL EMERGENCY CARE
• Post-DAAM airway placement must be confirmed and continually monitored with waveform capnography.
Jarvis JL, Lyng JW, Miller BL, Perlmutter MC, Abraham H, Sahni R. Prehospital Drug Assisted Airway Management: An NAEMSP Position Statement and Resource Document. *null*. 2022;26(sup1):42-53. doi:

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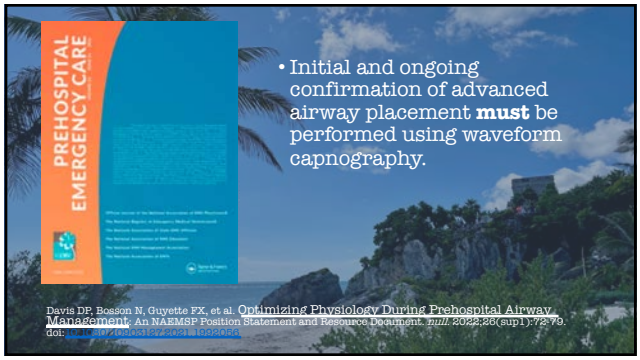
PREHOSPITAL EMERGENCY CARE
• Initial and ongoing confirmation of advanced airway placement **must** be performed using waveform capnography.
Davis DP, Bosson N, Guyette FX, et al. Optimizing Physiology During Prehospital Airway Management: An NAEMSP Position Statement and Resource Document. *null*. 2022;26(sup1):72-79. doi:

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Shameless plug time…
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