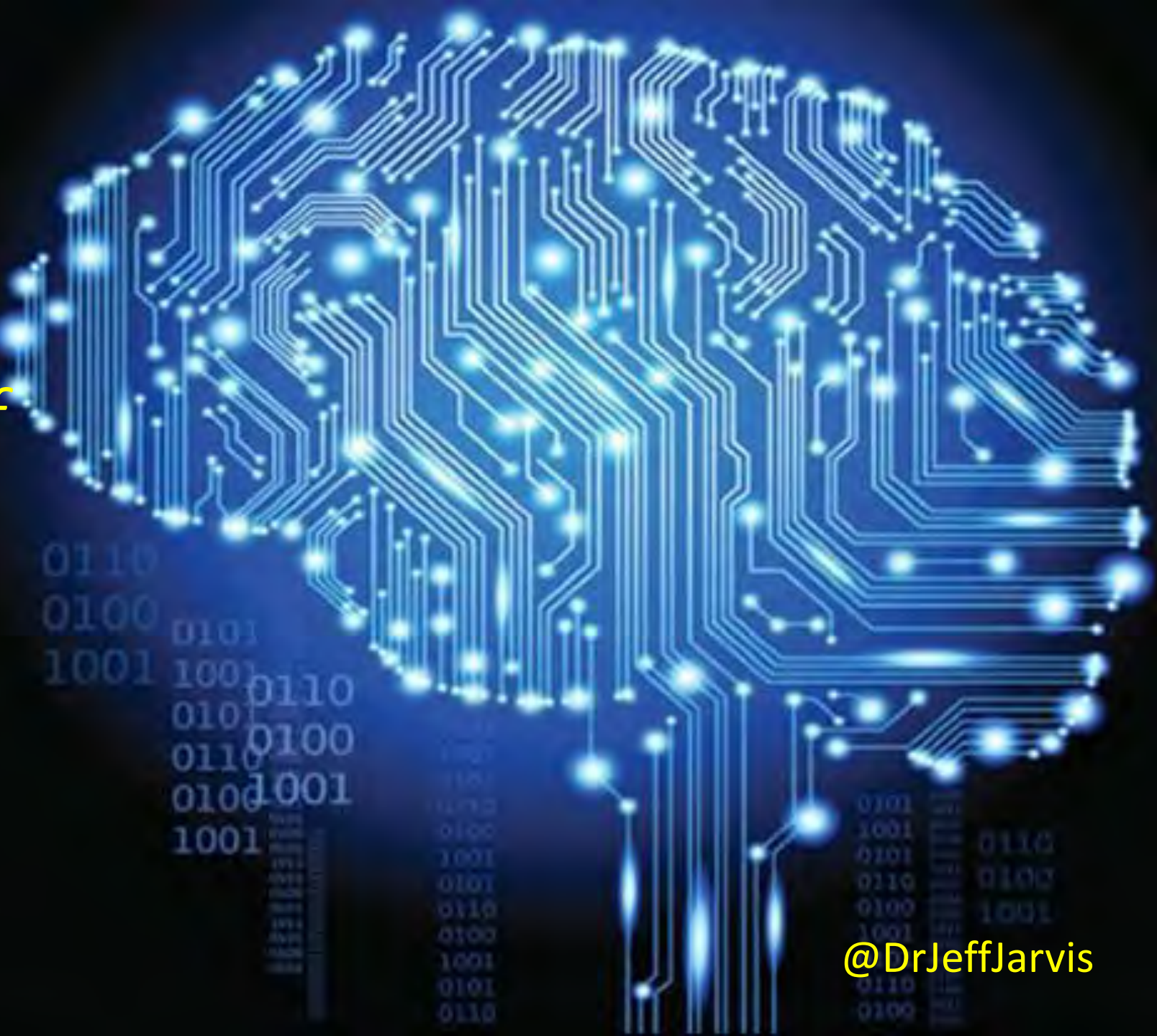


Signal to Noise: Finding *Interesting* Insights In A Ton of EMS Data



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No Conflicts to Disclose

The Dataset

2017 ESO

**>5 million EMS
calls (>80% 911)**

**941 consenting
Agencies**

The Top 3-ish...



...Primary Impressions

Rank	Impression	Frequency	%	Cumulative %
1	Injury	558,695	16.68	16.68
2	Generalized Weakness	243,521	7.27	23.95
3	Pain (Non-Traumatic)	230,831	6.89	30.84

With RLS Response

Rank	Impression	Frequency	%	Cumulative %
1	Injury	57,975	15.79	15.79
2	Respiratory Distress	35,806	9.75	25.54
3	Altered Mental Status	29,565	8.05	33.59

Impressions without Transport

Rank	Impression	Frequency	%	Cumulative %
1	No Complaints or Injury/Illness Noted	93,307	21.25	21.25
2	Injury	91,784	20.9	42.15
3	Other	27,154	6.18	48.33
4	Generalized Weakness	25,143	5.73	54.06
5	Diabetic Emergency	21,461	4.89	58.95
6	Behavioral / Psychiatric Disorder	19,171	4.37	63.32
7	Syncope / Fainting	15,391	3.51	66.83
8	Seizure	11,359	2.59	69.42
9	Respiratory Distress	10,973	2.5	71.92
10	Chest Pain / Discomfort	9,123	2.08	74

RLS Response to 911 calls?

RLS	3,302,067	(83.2%)
No RLS	667,327	(16.8%)
Total	3,969,394	(100%)

... Medications Given

Rank	Impression	Frequency	%	Cumulative %
1	Zofran	162,927	12.50	12.5
2	Fentanyl	130,157	10.00	22.6
3	Albuterol	121,237	9.33	31.9
4	Aspirin	108,334	8.34	40.2
5	Epinephrine 1:10	98,978	7.62	47.9
6	Nitrostat	81,899	6.31	54.2
7	Naloxone	55,792	4.30	58.5
8	Nitro Spray	48,318	3.72	62.2
9	Atrovent	47,861	3.68	65.9
10	Not Available	41,600	3.20	69.1
11	Morphine	37,928	2.92	72
12	Midazolam	32,056	2.47	74.5
13	Duoneb	30,983	2.39	76.8
14	Dextrose 50%	29,017	2.23	79.1
15	Solu-Medrol	23,853	1.84	80.9

RLS Transport from 911 call?

RLS transport	374,960	(9.4%)
No RLS transport	3,594,434	(90.6%)
Total	3,969,394	(100%)

A word about Odds Ratios...

$$OR = \frac{\textit{Rate of Event 1}}{\textit{Rate of Event 2}}$$

- $OR = 75/100 = 0.75$ ($1 - 0.75 = .25$ or 25% lower odds)
- $OR = 100/75 = 1.33$ ($1.33 - 1 = 0.33$ or 33% higher odds)
- $OR = 15/15 = 1.00$ ($1 - 1 = 0\%$ difference in odds)

- 95% Confidence Interval (Don't cross 1)



What factors are associated with achieving ROSC in cardiac arrest?

What was the rate of ROSC?

Yes	10,056	(28.5%)
No	25,272	(71.5%)
Total	35,328	

85% of all arrests had EMS resuscitation attempted

Disposition of these:

25% Dead on Scene

58% transported with RLS

6% transported without RLS

Were witnessed arrests a/w ROSC?

Not	16,853 (47.7%)	<i>Referent</i>
Bystander	8,919 (25.2%)	3.7 (3.5–3.9)
EMS	5,359 (15.2%)	4.5 (4.2–4.8)
Family	2,854 (8.1%)	2.9 (2.7–3.2)
Total	35,328 (100%)	

Was arrest etiology a/w ROSC?

Cardiac	27,718	(78.5%)	<i>referent</i>
Resp	3,668	(10.4%)	1.92 (1.79–2.06)
Overdose	696	(2.0%)	1.44 (1.23–1.69)
Drowning	118	(0.3%)	1.23 (0.83–1.81)
Other	3,128	(8.9%)	0.87 (0.80–0.95)
Total	35,328	(100%)	

Was bystander AED use a/w ROSC?

Not used	19,810	(56.1%)	<i>referent</i>
Used	15,518	(43.9%)	1.4(1.4 – 1.5)
Total	35,328	(100%)	

Was the initial rhythm a/w ROSC?

Not shockable	29,236 (82.8%)	<i>referent</i>
Shockable	6,092 (17.2%)	3.2 (3.0–3.4)
Total	35,328 (100%)	

Were Pre-Arrival instructions a/w ROSC?

Not Provided	13,369 (48%)	<i>Referent</i>
PAI Provided	14,490 (52%)	1.3 (1.3 - 1.4)
Total	27,859	

*Includes only those with known prearrival status

Was Defibrillation a/w ROSC?

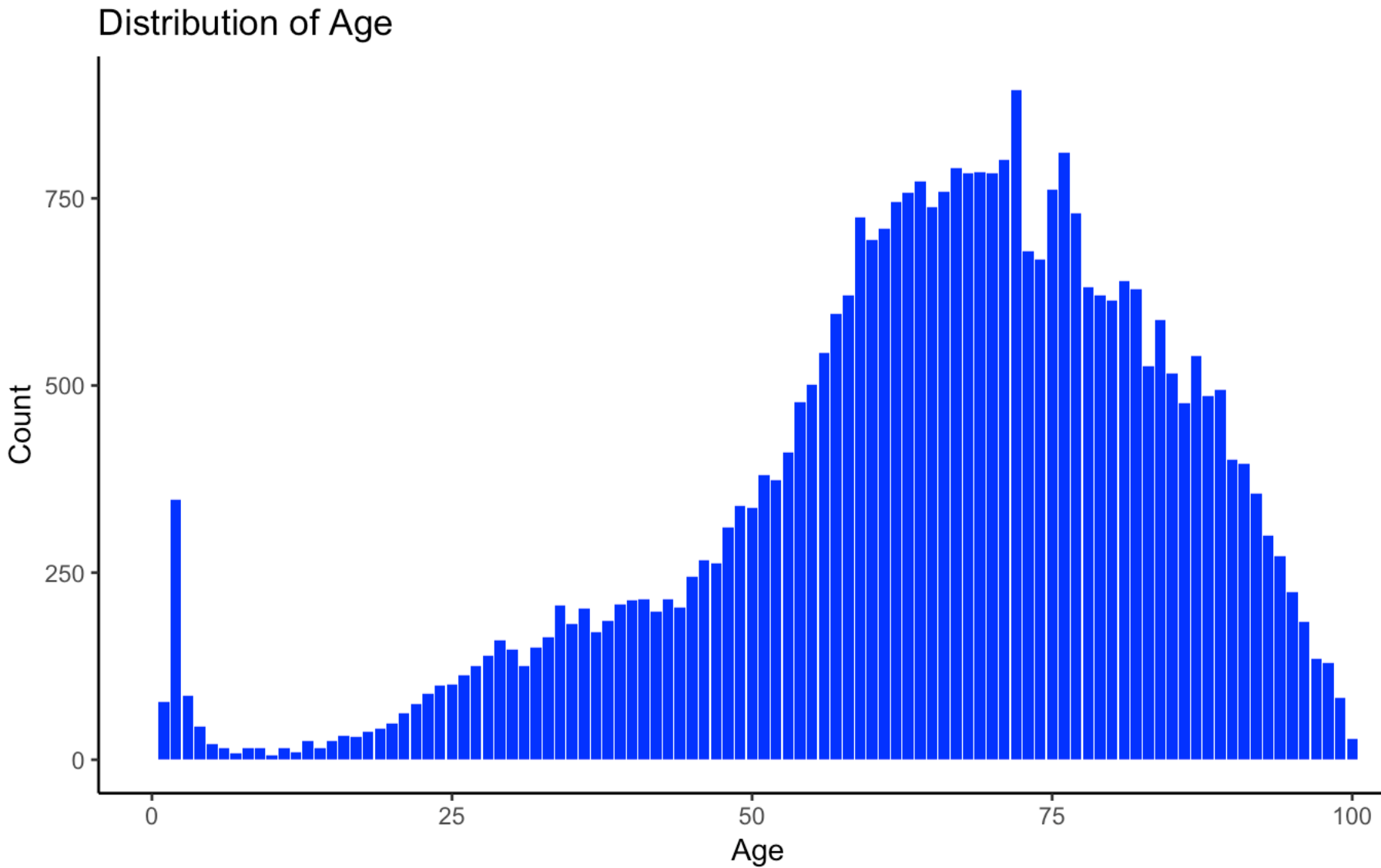
No Defib	30,173	(85.4%)	<i>referent</i>
Defib	5,155	(14.6%)	2.8 (2.6–2.9)
Total	35,328	(100%)	

Warning! Statistical *uckery

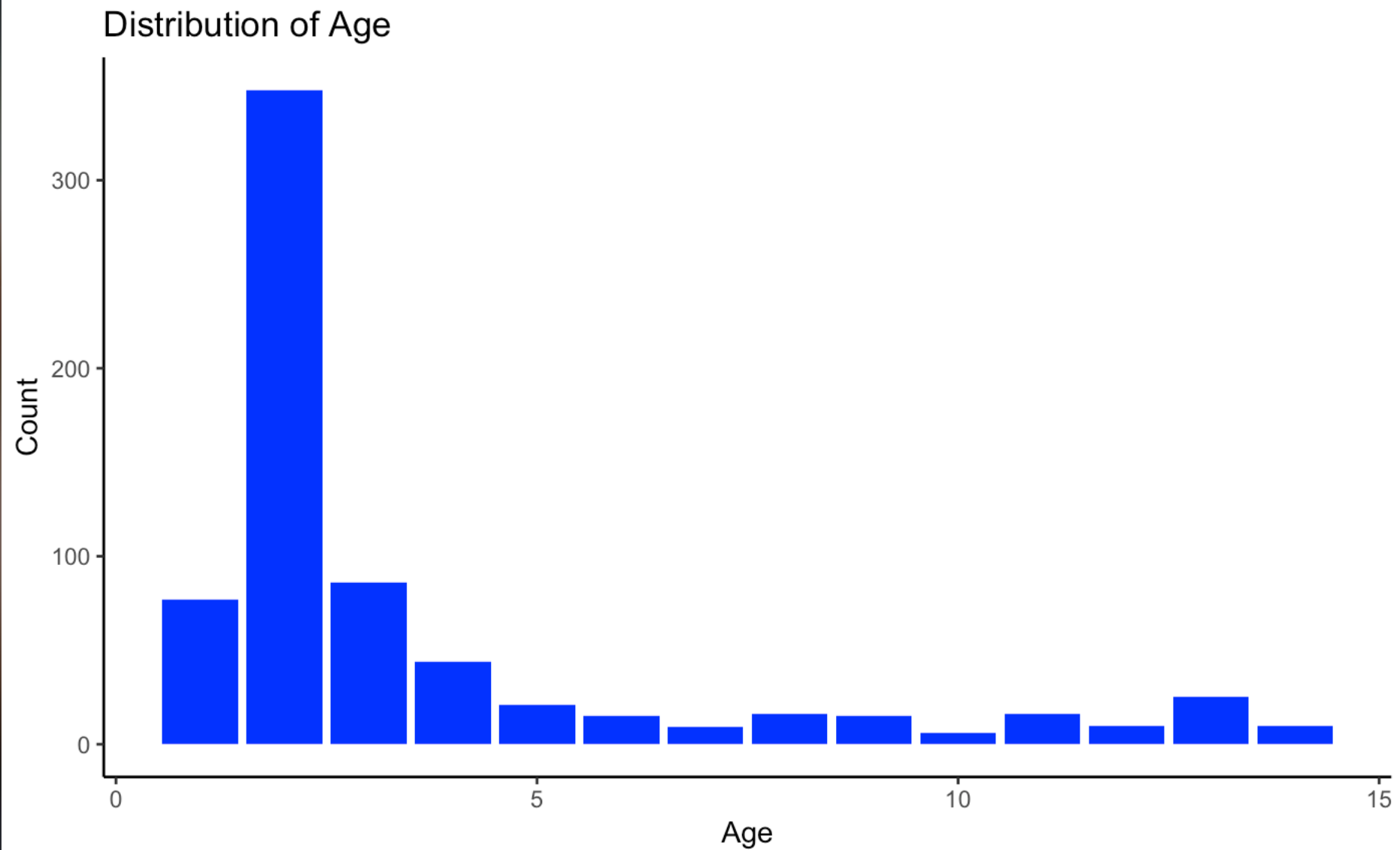
Was the use of CPR Feedback a/w ROSC?

No feedback	25,288	(72.1%)	<i>referent</i>
CPR feedback	9,840	(27.9%)	2.1 (2.0–2.2)
Total	35,328	(100%)	

Is age a/w ROSC?



Among kids, is age a/w ROSC?



ROSC by Etiology among Pedis (<14)

Cardiac	241 (34.3%)	Referrant
Respiratory	249 (35.4%)	1.83 (1.15 – 2.96)
Other	181 (25.7%)	1.11 (0.63 – 1.91)
Drowning	32 (4.6%)	3.78 (1.66 – 8.39)
Overdose	0 (0%)	

ROSC by Ethnic Identity

White	22,182 (74.6%)	Referent
Asian	289 (1.0%)	1.35 (1.05-1.72)
Black	6,559 (22.0%)	0.90 (0.85-0.96)
Hispanic	623 (2.1%)	1.00 (0.84-1.20)
Native Am.	101 (0.3%)	1.01 (0.65-1.54)
Total	29,754 (100%)	

*Includes only those with known identity

Was the type of initial airway a/w ROSC?

None	14,872 (42.1%)	<i>Referent</i>
ETI	14,513 (41.1%)	2.0 (1.9 – 2.1)
SGA	5,892 (16.7%)	1.7 (1.6 – 1.8)
FONA	51 (0.1%)	1.1 (0.6 – 1.8)
Total	35,328 (100%)	

Was First Pass Success a/w ROSC?

No	4,631 (22.6%)	<i>referent</i>
FPS	15,825 (77.4%)	1.4 (1.3 - 1.5)
Total	20,456 (100%)	

* Excludes pt with no AAM attempts

Signal or Noise?

Was Epinephrine use a/w ROSC?

No Epi	997 (4.1%)	<i>referent</i>
Epi	23,479 (95.9%)	15.1 (12.5 – 18.3)
Total	24,476 (100%)	

* Excludes pts who received no medications of any kind

Was early Epinephrine use a/w ROSC?

< 10 min		<i>referent</i>
10 – 20 min	0.95	(0.86 – 1.01)
> 20 min	.80	(0.71 – 0.89)

* Excludes pt who received no medications of any kind

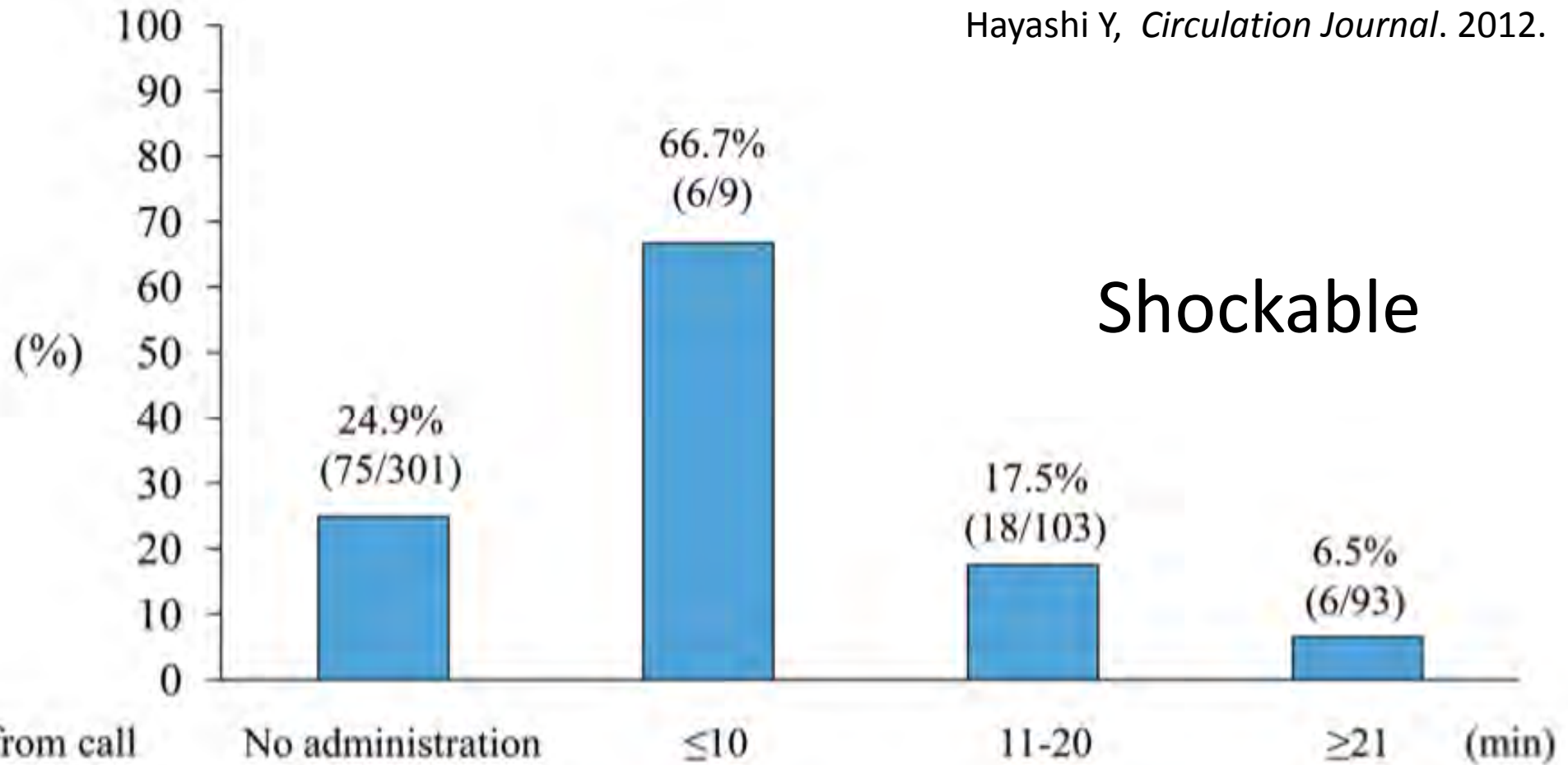
All rhythms, non-trauma OOHCA in Osaka, Japan
Bystander-witnessed
3,161 patients, stratified by initial rhythm

Evaluated survival in:

No epinephrine:	2,148 (68%)
Epi:	1,103 (32%)
<10 min:	25 (0.8%)
10-20 min:	486 (15%)
>20 min:	502 (16%)

Hayashi Y, et al. Impact of Early Intravenous Epinephrine Administration on Outcomes Following Out-of-Hospital Cardiac Arrest. *Circulation Journal*. 2012; 76: 1639-1645.

A



Time from call until administration

Crude OR
(95% CI)

Reference

6.03
(1.47-24.69)

0.64
(0.36-1.13)

0.21
(0.09-0.50)

Adjusted OR
(95% CI)

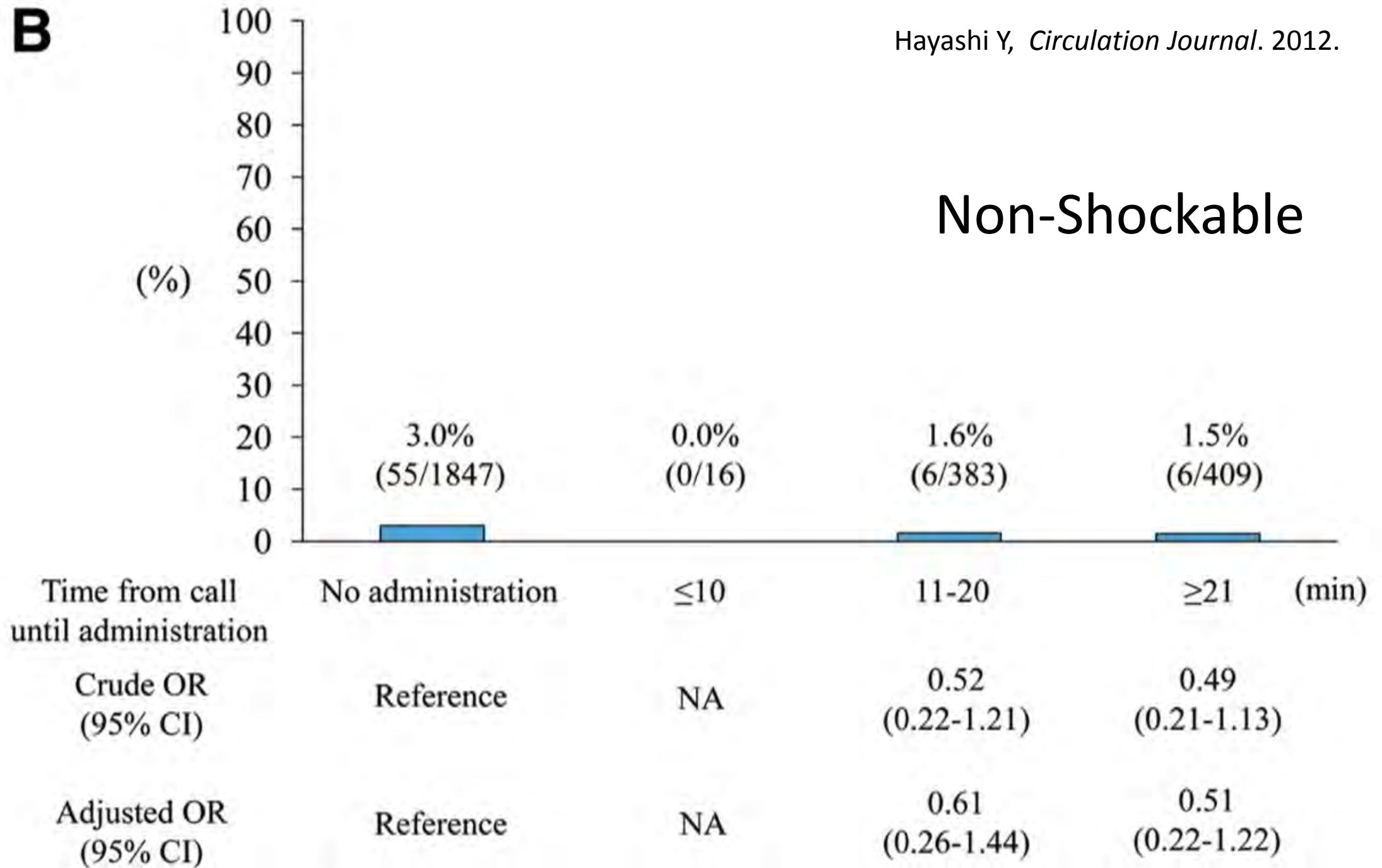
Reference

6.34
(1.49-27.02)

0.65
(0.36-1.20)

0.19
(0.08-0.47)

Non-Shockable



PARAMEDIC-2

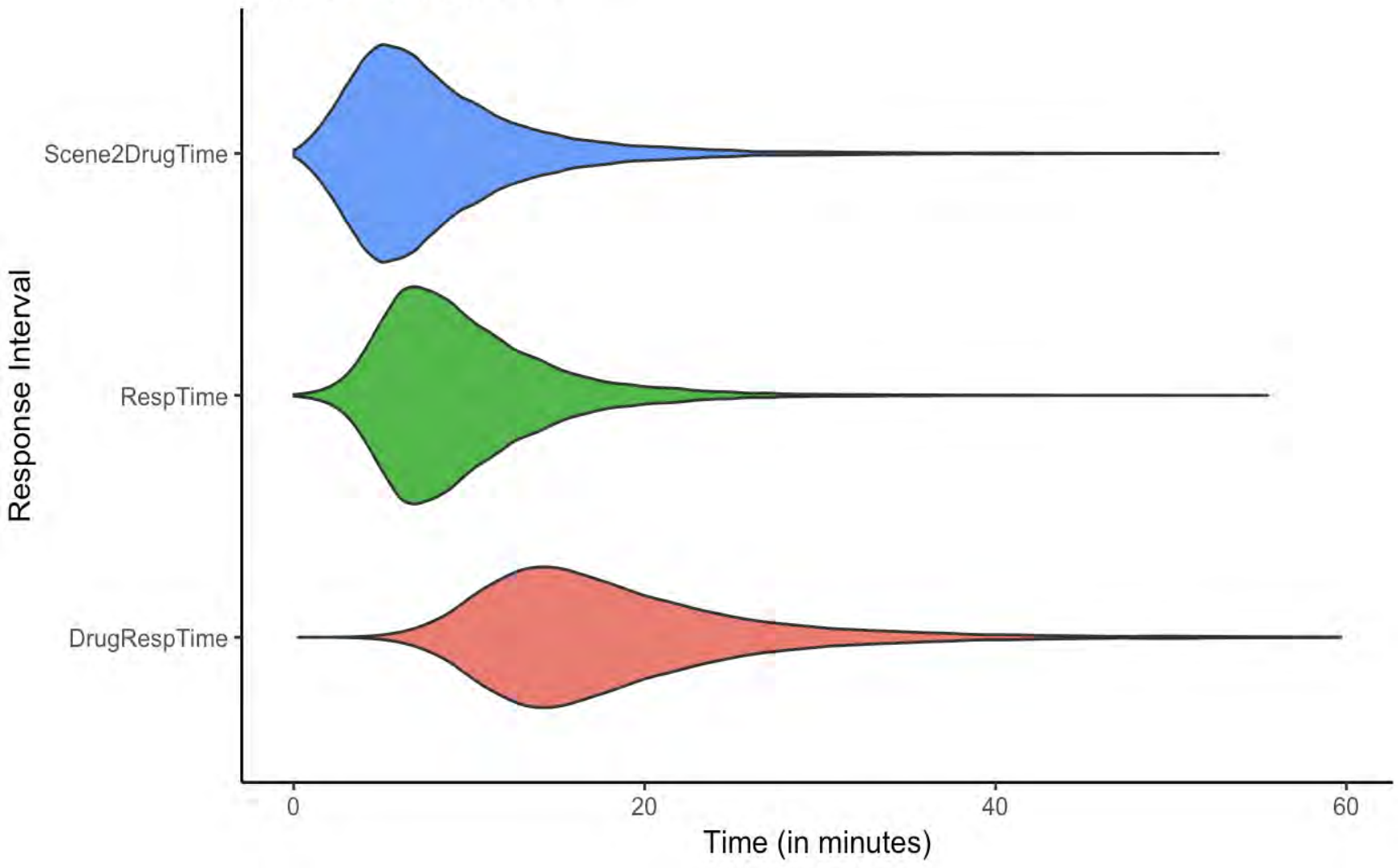
- Better ROSC, Survival to D/C with epi
- More neurologic devastation with epi

Table 2. Intervals between Key Events and Initial Response to Resuscitation.*

Variable	Epinephrine (N = 4015)	Placebo (N = 3999)
Interval between emergency call and ambulance arrival at scene		
No. of patients in analysis	4015	3999
Median (IQR) — min†	6.7 (4.3–9.7)	6.6 (4.2–9.6)
Interval between emergency call and administration of trial agent		
No. of patients in analysis	3975	3949
Median (IQR) — min†	21.5 (16.0–27.3)	21.1 (16.1–27.4)

- But this doesn't apply in the US b/c we give Epi WAY faster, right?

Time to Epinephrine



Mean Median (IQR)

8.4 7.0 (4.8, 10.4)

9.8 8.7 (6.4, 12.0)

18.2 16.5 (13.0, 21.5)

ROSC as function of time to Epinephrine, all rhythms

- Continuous: OR 0.996 (95%CI 0.993 – 0.998)
 - 0.4% decreased odds of ROSC with each additional minute until epinephrine

Interval	OR	95%CI
< 5 minutes	<i>Referent</i>	
5 – 10 minutes	0.91	(0.84 – 0.97) *
10 – 15 minutes	0.84	(0.77 - 0.93) *
15 – 20 minutes	0.81	(0.71 – 0.92) *
20 – 25 minutes	1.07	(0.91 – 1.26)
25 – 30 minutes	1.08	(0.85 – 1.37)
> 30 minutes	1.49	(1.2 – 1.84) *

Time to Epi in Shockable Rhythms

Interval	OR	95%CI
< 5 minutes	<i>Referent</i>	
5 – 10 minutes	0.78	(0.67 – 0.91) *
10 – 15 minutes	0.65	(0.53 – 0.81) *
15 – 20 minutes	0.60	(0.45 – 0.81) *
20 – 25 minutes	0.75	(0.52 – 1.08)
25 – 30 minutes	0.57	(0.32 – 1.01)
> 30 minutes	0.96	(0.61 – 1.5)

Initial decrease in odds of ROSC until >20 minutes, then no difference.

Time to Epi in Non-Shockable Rhythms

Interval	OR	95%CI
< 5 minutes	<i>Referent</i>	
5 – 10 minutes	0.96	(0.89 – 1.04)
10 – 15 minutes	0.93	(0.83 – 1.03)
15 – 20 minutes	0.89	(0.22 – 1.03)
20 – 25 minutes	1.19	(0.98 – 1.67)
25 – 30 minutes	1.28	(0.98 – 1.66)
> 30 minutes	1.70	(1.34 – 2.15) *

No difference in odds of ROSC until >30 minutes, then an increase.

Time to Epi in Peds (<14)

Interval	OR	95%CI
< 5 minutes	<i>Referent</i>	
5 – 10 minutes	1.03	(0.71 – 1.50)
10 – 15 minutes	0.84	(0.50 – 1.40)
15 – 20 minutes	1.7	(0.79 – 3.57)
20 – 25 minutes	0.80	(0.25 – 2.15)
25 – 30 minutes	0.73	(0.11 – 3.13)
> 30 minutes	1.07	(0.33 – 3.02)

Not enough patients to split into shockable/not-shockable
No difference in odds of ROSC at any point.

Was Lidocaine, Amiodarone, or no anti-arrhythmic use in shockable rhythms a/w ROSC?

None	2,238	(49.0%)	<i>referent</i>
Amio	1,905	(41.7%)	1.19 (1.05 to 1.25)
Lido	427	(9.3%)	1.71 (1.39 to 2.10)
Total	4,570	(100%)	

* Includes only pts with initial shockable rhythm & Epi given

Was Bicarb use a/w ROSC?

No Bicarb	23,988 (98.0%)	<i>referent</i>
Bicarb	488 (2%)	1.5 (1.2 - 1.8)
Total	24,476 (100%)	

* Excludes pt who received no medications of any kind

Was Service level use a/w ROSC?

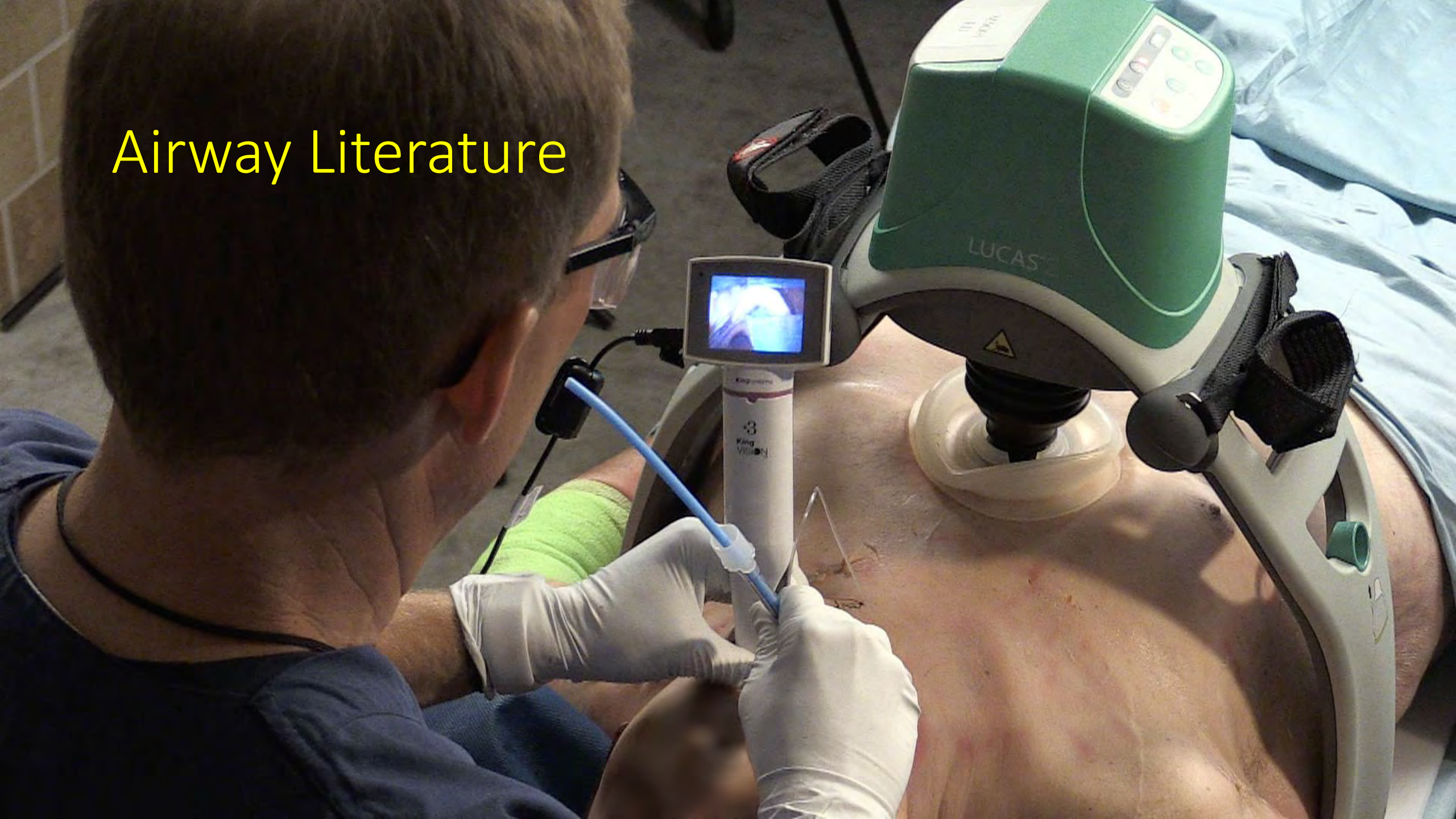
BLS	1,256 (6.2%)	<i>referent</i>
ALS	18,214 (90.5%)	3.6 (3.0 – 4.4)
Critical Care	651 (3.2%)	8.6 (6.6 – 10.9)
Total	20,121 (100%)	

* Excludes pts w/o a documented service level

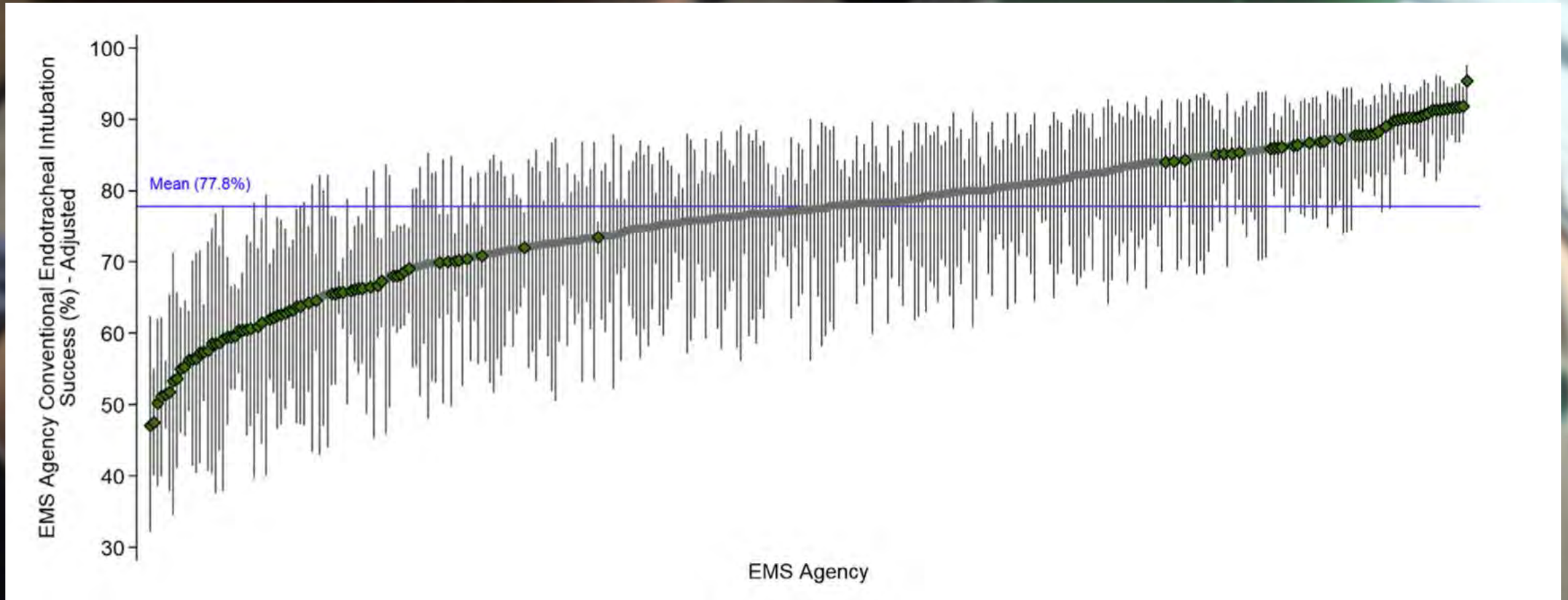
Is ITD use associated with ROSC?

Not Used	37,442	(92.7%)	<i>referent</i>
Used	2,943	(7.3%)	1.08 (0.98 – 1.19)
Total	40,385	(100%)	

Airway Literature



Is there much variation in ETI FPS?



Wang HE, Donnelly JP, Barton D, Jarvis JL. Assessing Advanced Airway Management Performance in a National Cohort of Emergency Medical Services Agencies. *Ann Emerg Med.* 2018; 71: 597-607.e3.

What is the plateau point?

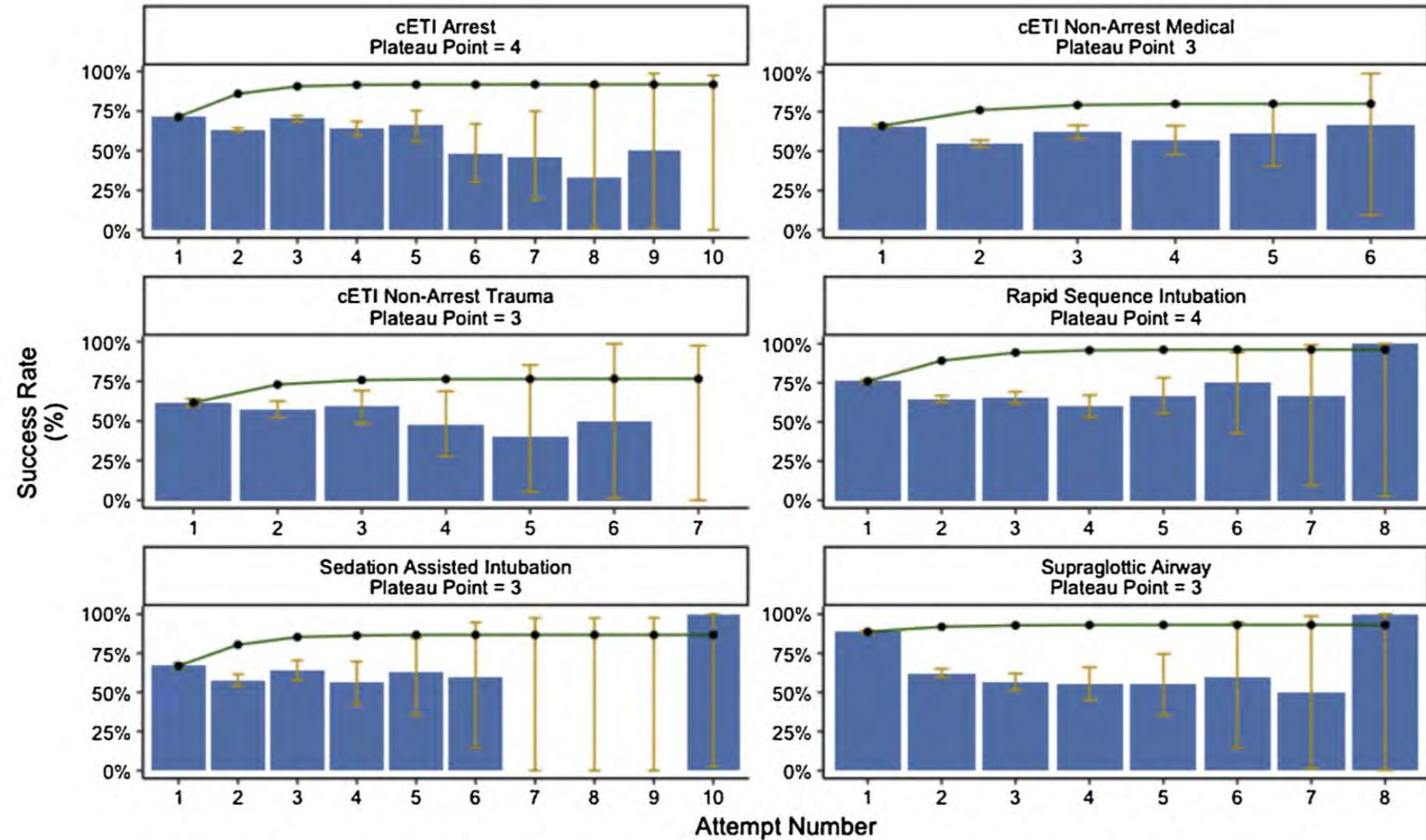
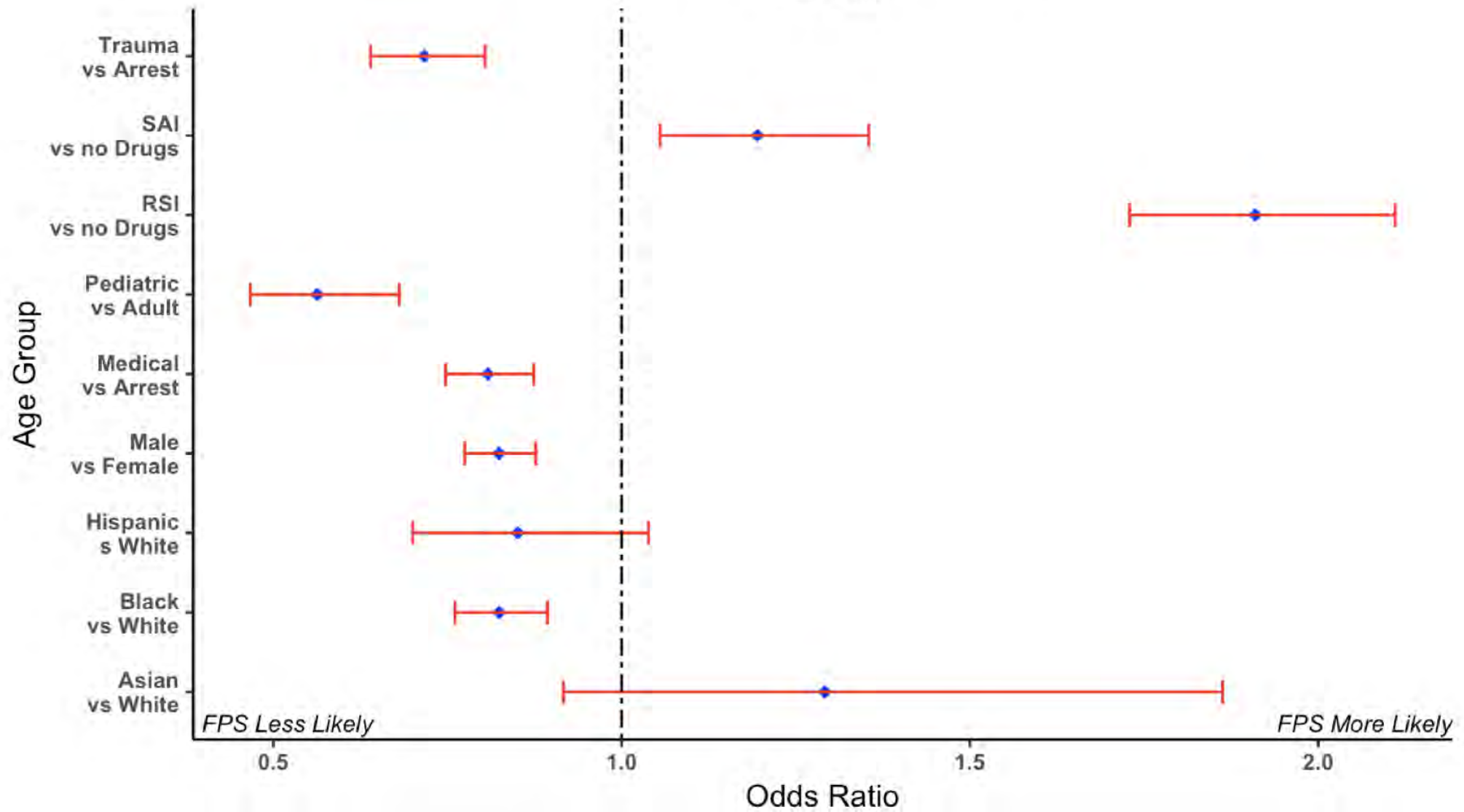


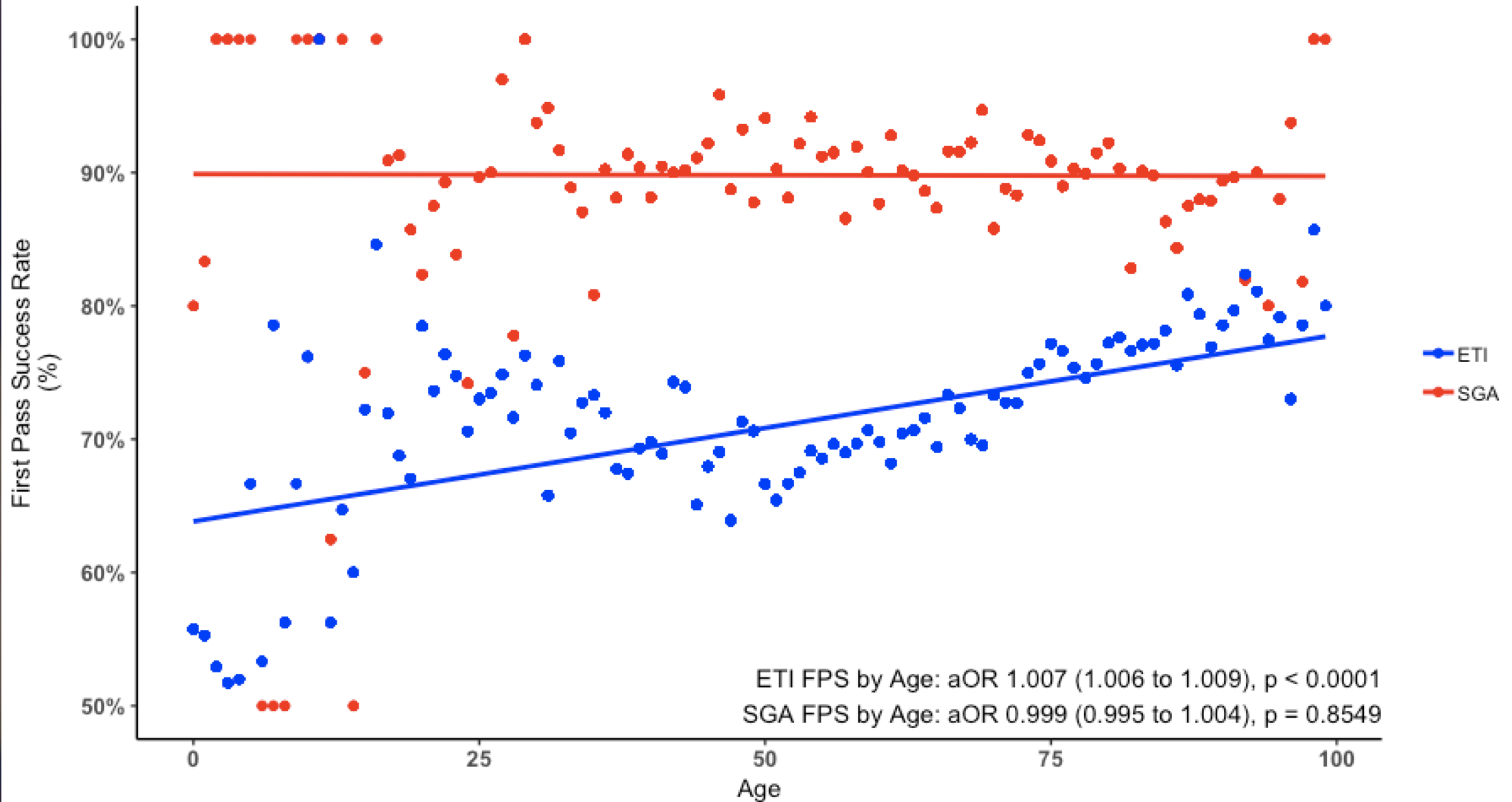
Fig. 1. Per-Attempt (bars) and Cumulative (line) Intubation Success Rates and 95% Confidence Intervals (error bars).

Likelihood of First Pass Success By Age Group ETI Only

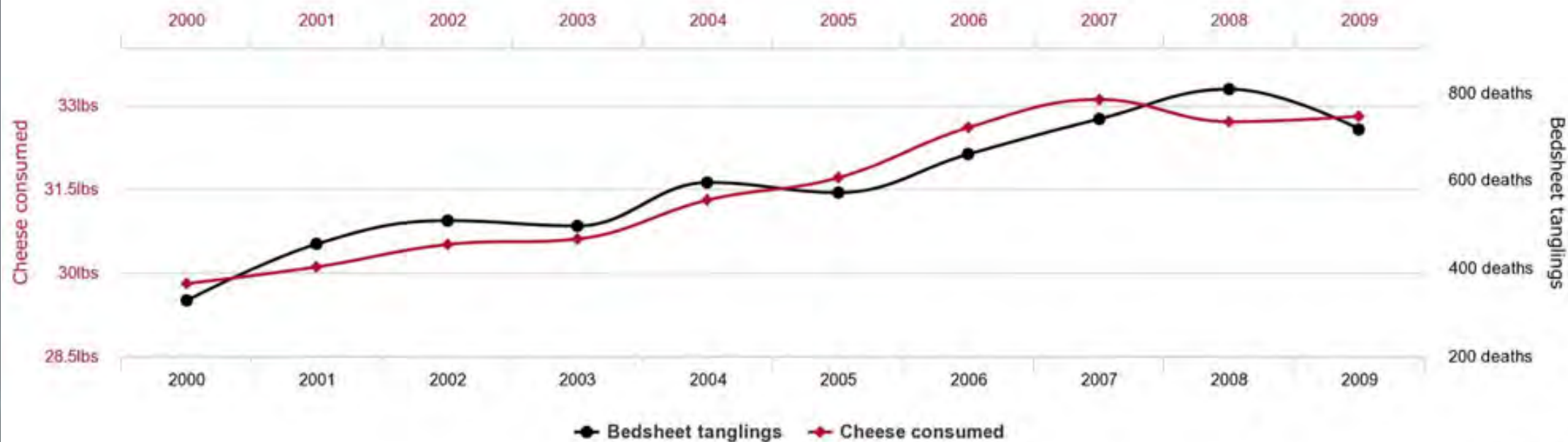


Jarvis, JL, Wampler, D, Wang, HE. First Pass Success Rates of Out-Of-Hospital Advanced Airway Management in Adults and Children. Poster.

FPS by Age



PER CAPITA CHEESE CONSUMPTION
CORRELATES WITH
NUMBER OF PEOPLE WHO DIED BECOMING TANGLED IN
THEIR BEDSHEETS



tylervigen.com

SOURCE: Spurious Correlations

Garbage In,
Garbage Out



More questions?

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