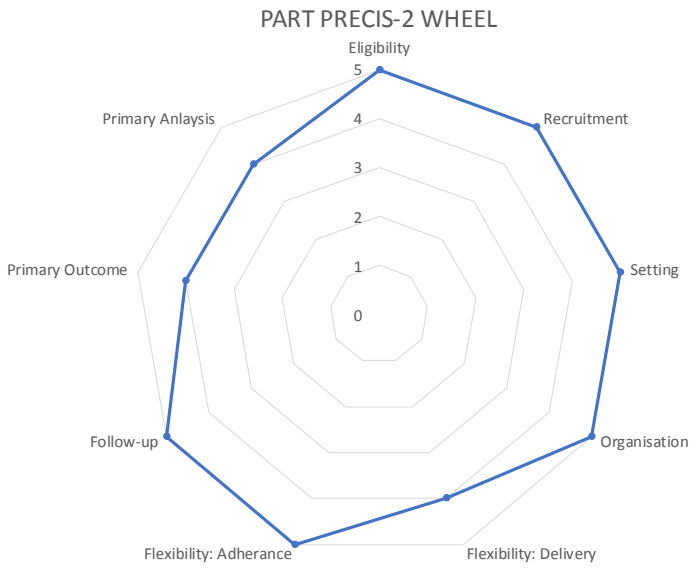
Supplementary Online Content

Wang HE, Schmicker RH, Daya MR, et al. 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.* doi:10.1001/jama.2018.7044

This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix 1. PRECIS-2 Wheel and Domains

PRagmatic-Explanatory Continuum Indicator Summary 2 (PRECIS-2) wheel. Diagram summarizes pragmatic dimensions of the trial. Scales range from 0 (not pragmatic) to 5 (very pragmatic) in each domain. Adopted from https://www.precis-2.org/ and Loudon K, Treweek S, Sullivan F, Donnan P, Thorpe KE, Zwarenstein M. The PRECIS-2 tool: designing trials that are fit for purpose. *BMJ.* 2015;350:h2147.



***PRECIS-2* domains:**

Eligibility -to what extent are the participants in the trial similar to those who would receive this intervention if it was part of usual care?

Recruitment - how much extra effort is made to recruit participants over and above what that would be used in the usual care setting to engage with patients?

Setting - how different is the setting of the trial and the usual care setting?

Organisation - how different are the resources, provider expertise and the organisation of care delivery in the intervention arm of the trial and those available in usual care?

Flexibility (delivery) - how different is the flexibility in how the intervention is delivered and the flexibility likely in usual care?

Flexibility (adherence) - how different is the flexibility in how participants must adhere to the intervention and the flexibility likely in usual care?

Follow-up - how different is the intensity of measurement and follow-up of participants in the trial and the likely follow-up in usual care?

Primary outcome - to what extent is the trial's primary outcome relevant to participants?

Primary analysis - to what extent are all data included in the analysis of the primary outcome?

eAppendix 2. Trial Inclusion and Exclusion Criteria

ETI = endotracheal intubation. LT = laryngeal tube. EMS = Emergency Medical Services.

Inclusion Criteria

- Adult (age ≥18 years or per local interpretation), non-traumatic out-of-hospital cardiac arrest
- Treated by EMS personnel
- Requiring advanced airway insertion (ETI, LT) or ventilatory support (bag-valve-mask ventilation)

Exclusion Criteria

- Known pregnancy
- Known prisoners
- Major facial trauma
- Major bleeding or exsanguination
- ET tube, LT or other advanced airway insertion prior to ROC EMS arrival
- Pre-existing tracheostomy
- Obvious asphyxial cardiac arrest (choking or hanging)
- Left ventricular assist device or total artificial heart
- Pre-existing “do-not-attempt-resuscitation” orders
- Inter-facility transports
- Presence of a “do not enroll” bracelet
- Initial care by non-trial EMS agency capable of performing ETI, LT or other advanced airway insertion

eAppendix 3. Study Compliance Benchmarks for the Trial

A Study Monitoring Committee provided oversight over EMS agency and regional coordinating center study performance. The committee worked with regional coordinating centers to develop remediation plans for EMS agencies or regional centers not meeting study compliance criteria, including suspension of EMS agency participation if necessary. BVM = bag-valve-mask ventilation. ETI = endotracheal intubation. LT = laryngeal tube. EMS = Emergency Medical Services.

Protocol Compliance

- First attempted airway consistent with randomized airway assignment. Must satisfy (a) or (b) to be compliant. BVM-use only (without ETI or LT) is considered compliant.
    - [85% compliant with randomized assignment (cumulative or 60-day window)], OR
    - [No more than 4 cases non-compliant in 60-day window]

Data Availability

- Success and number of attempts on each attempted airway device. Must satisfy (a) or (b) to be compliant. BVM-use only (without ETI or LT) is considered compliant.
    - [85% available data (cumulative or 60-day window)], OR
    - [No more than 4 cases missing data in 60-day window]
- 72-hour vital status after 90 days post episode
    - [85% available data (cumulative or 90-day window)], OR
    - [No more than 2 cases missing data in 90-day window]
    - No penalty if site can verify reasonable efforts to obtain data.

Data Entry and Completion

- Entry of screened episodes ≤7 days of episode
    - [85% compliant (cumulative or 60-day window)], OR
    - [No more than 4 cases non-compliant in 60-day window]
- Completion of enrollment, time record and out-of-hospital forms ≤60 days of episode
    - [85% compliant (cumulative or 60-day window)], OR
    - [No more than 4 cases non-compliant in 60-day window]
- Completion of Emergency Department/Hospital/Procedures forms ≤90 days of discharge
    - [85% compliant (cumulative or 90-day window)], OR
    - [No more than 2 cases non-compliant in 90-day window]
    - No penalty if site can verify reasonable efforts to obtain data.

eAppendix 4. Estimates of Sample Size and Interim Stopping Boundaries

Because no prior OHCA trials had reported 72-hour survival, we re-analyzed data from the prior ROC PRIMED trial (Aufderheide, et al. and Stiell, et al., NEJM 2011). We observed baseline 72-hour survival rates of 8.7% for supraglottic airways and 13.7% for ETI (72-hour survival difference 5.0%). Because the trial was to include US EMS agencies only, 1) we further narrowed the PRIMED data to US agencies, and 2) we excluded data from Seattle-King County EMS agencies, which did not perform supraglottic airway insertion; these exclusions resulted in estimated baseline 72-hour survival of 16.2% for ETI and 11.1% for LT (baseline effect size 5.1%). By study team consensus, we selected a more conservative value of 4.5% as the difference to power the study.

	Statistical Power (1-β)		
Effect Size (Absolute Difference)	**80%**	**85%**	**90%**
4.0%	2,856	3,266	3,892
4.5%	2,284	**2,612**	3,112
5.0%	1,872	2,142	2,550

Table 1 - Estimated minimum sample sizes for a range of effect sizes and statistical power

To account for patients receiving bag-valve-mask only, we increased the baseline LT survival rate to 13.7%. Additional considerations included accounting for a portion of cases (approximately 17%) receiving receive bag-valve-mask ventilation only, a 5% loss of precision due the cluster-crossover design of the trial and accommodating up to 4 analysis (3 interim + 1 final). To achieve 85% power to detect an effect size of 4.5%, we projected that we would need to enroll a minimum of 2,612 patients. (Table 2) We decided to increase the minimum sample size to 3,000 to account for potential drop-outs, loss-to-follow-up, and cases receiving only bag-valve-mask ventilation.

Since ETI is generally considered to be more complex and resource intensive than LT insertion, we defined early termination boundaries at a higher superiority threshold for [ETI over LT] (e.g., ≥12.5% absolute 72-hour survival difference in favor of ETI at first interim analysis) than for [LT over ETI] (e.g., ≥10.8% absolute 72-hour survival difference in favor of LT at first interim analysis). We did not include any futility boundaries because obtaining estimates in either direction was considered informative.

			Lower Stopping Boundary (LT Better)			
Analysis	**Cum. Sample Size**	**Prop. Max Stat Info**	**Absolute Difference**	**Adjusted Difference**	**95% Confidence Interval**	**P-value**
1	654	0.25	-0.108	-0.098	(-0.154, -0.041)	0.001
2	1,306	0.50	-0.102	-0.092	(-0.135, -0.053)	<0.001
3	1,958	0.75	-0.092	-0.084	(-0.120, -0.052)	<0.001
4	2,612	1.00	-0.029	-0.029	(-0.059, 0.000)	0.050
			Upper Stopping Boundary (ETI Better)			
Analysis	**Cum. Sample Size**	**Prop. Max Stat Info**	**Absolute Difference**	**Adjusted Difference**	**95% Confidence Interval**	**P-value**
1	654	0.25	0.125	0.116	(0.058, 0.172)	<0.001
2	1,306	0.50	0.118	0.109	(0.069, 0.151)	<0.001
3	1,958	0.75	0.106	0.099	(0.066, 0.135)	<0.001
4	2,612	1.00	0.029	0.029	(0.000, 0.059)	0.050

Table 2 - Interim Stopping Boundaries for 72-Hour Survival

eTable 1. EMS Agencies Participating in the Trial

Regional Coordinating Center	EMS Agency	Location	Population Settings	Annual 911 Emergency Responses	Care Level of Responding Units	LT Use by BLS Personnel
Alabama	Bessemer Fire Department	Bessemer, AL	Urban/Suburban	7,900	ALS and BLS	No
Alabama	Birmingham Fire and Rescue Service	Birmingham, AL	Urban/Suburban	55,800	ALS and BLS	No
Dallas	Garland Fire Department	Garland, TX	Urban/Suburban	24,800	ALS	N/A
Dallas	Irving Fire Department	Irving, TX	Urban/Suburban	23,300	ALS	N/A
Dallas	MedStar Mobile Healthcare	Fort Worth, TX	Urban/Suburban	123,000	ALS and BLS	Yes
Dallas	Mesquite Fire Department	Mesquite, TX	Urban/Suburban	18,900	ALS	N/A
Milwaukee	City of Milwaukee Fire Department	Milwaukee, WI	Urban	125,000	ALS and BLS	Yes
Milwaukee	Cudahy Fire Department	Cudahy, WI	Suburban	2,300	BLS	Yes
Milwaukee	Franklin Fire Department	Franklin, WI	Suburban	4,100	ALS and BLS	Yes
Milwaukee	Greendale Fire Department	Greendale, WI	Suburban	2,300	ALS and BLS	Yes
Milwaukee	Greenfield Fire Department	Greenfield, WI	Urban/Suburban	4,800	ALS and BLS	Yes
Milwaukee	Hales Corners Fire Department	Hales Corners, WI	Suburban	1,200	BLS	Yes
Milwaukee	North Shore Fire Department	Brown Deer, WI	Urban/Suburban	8,000	ALS and BLS	Yes
Milwaukee	Oak Creek Fire Department	Oak Creek, WI	Suburban	4,000	ALS and BLS	Yes
Milwaukee	South Milwaukee Fire Department	South Milwaukee, WI	Suburban	3,200	ALS and BLS	Yes
Milwaukee	St. Francis Fire Department	St. Francis, WI	Suburban	1,600	BLS	Yes
Milwaukee	Wauwatosa Fire Department	Wauwatosa, WI	Urban/Suburban	7,000	ALS and BLS	Yes
Milwaukee	West Allis Fire Department	West Allis, WI	Urban	10,000	ALS and BLS	Yes
Pittsburgh	Medical Rescue Team South Authority	Mt. Lebanon, PA	Urban/Suburban	10,000	ALS and BLS	No
Pittsburgh	Scott Township EMS	Scott Township, PA	Urban/Suburban	2,800	ALS and BLS	No
Pittsburgh	Tri-Community South EMS	Bethel Park, PA	Urban/Suburban	7,100	ALS	N/A
Portland	Clackamas Fire District # 1	Clackamas County, OR	Urban/Suburban/Rural	23,600	ALS and BLS	Yes
Portland	Hillsboro Fire Department	Hillsboro, OR	Urban/Suburban	6,700	ALS and BLS	Yes
Portland	Lake Oswego Fire	Lake Oswego, OR	Urban/Suburban	3,100	ALS and BLS	Yes
Portland	Metro West Ambulance	Hillsboro, OR	Urban/Suburban/Rural	46,400	ALS	N/A
Portland	Skamania County EMS	Stevenson, WA	Rural	1,500	ALS and BLS	Yes
Portland	Tualatin Valley Fire & Rescue	Tigard, OR	Urban/Suburban/Rural	32,400	ALS and BLS	Yes

EMS = Emergency Medical Services. ALS = advanced life support. BLS = basic life support. LT = laryngeal tube. N/A = not applicable.

eTable 2. Study Outcomes

Outcome Measure	Definition, Criteria or Notes
Primary Outcome - 72-hour survival	- Vital status (alive/dead) 72-hours after onset of cardiac arrest or initiation of resuscitation.
Secondary Outcomes - Return of spontaneous circulation	- Presence of pulses on EMS arrival at receiving Emergency Department arrival.
- Survival to hospital discharge	- Vital status (alive/dead) on hospital discharge.
- Neurologically-intact survival to hospital discharge	- Modified Rankin Score (MRS) ≤3 on hospital discharge. Dead defined as MRS=6.
Airway Management Process and Adverse Events	
- Sequence of ETI/LT attempts	- ETI-first vs LT-first.
- Number of ETI/LT attempts	- Multiple attempts defined as ≥3 insertion attempts.
- Success of ETI/LT insertion efforts	- Successful placement reported by EMS.
- Successful airway insertion time, or time advanced airway efforts abandoned	- Reported by EMS personnel.
- Initial airway course in receiving Emergency Department	- Emergency Department management of EMS-placed airway.
- Unrecognized airway misplacement or dislodgement	- Unrecognized EMS endotracheal tube placement in the esophagus or hypopharynx, or displacement of a correctly placed ET tube. Does not include instances of immediately recognized ET tube misplacement. Does not include ED airway misplacements.
- Inadequate ventilation	- EMS reported inadequate ventilation prompting EMS to change airway device.
- Airway swelling or edema	- Determined from medical records for first 24 hours of hospitalization.
- Oropharyngeal or hypopharyngeal injury	- Determined from hospital records for first 24 hours of hospitalizations.
- Pneumothorax	- Determined from first Emergency Department chest x-ray.
- Pneumonia and aspiration pneumonitis	- Determined from radiology interpretation of chest x-rays for first 72-hours of hospitalization.

ETI = endotracheal intubation. LT = laryngeal tube. EMS = Emergency Medical Services.

eTable 3. Characteristics of Out-of-Hospital Airway Management Interventions

Includes only interventions carried out by EMS units participating in the trial. Observations based upon EMS and hospital records.

Characteristic	Laryngeal Tube N=1505	Endotracheal Tube N=1499
Initial advanced airway management attempt, n / N [%]		
ALS endotracheal tube	51 / 1505 (3.4%)	688 / 1499 (45.9%)
ALS laryngeal tube	856 / 1505 (56.9%)	72 / 1499 (4.8%)
ALS bag-valve-mask only	119 / 1505 (7.9%)	131 / 1499 (8.7%)
BLS laryngeal tube + continued ALS laryngeal tube use	88 / 1505 (5.8%)	14 / 1499 (0.9%)
BLS laryngeal tube + ALS endotracheal tube	0 / 1505 (0.0%)	14 / 1499 (0.9%)
BLS bag-valve-mask + ALS endotracheal tube	16 / 1505 (1.1%)	458 / 1499 (30.6%)
BLS bag-valve-mask + ALS laryngeal tube	341 / 1505 (22.7%)	52 / 1499 (3.5%)
BLS bag-valve-mask + ALS bag-valve-mask	33 / 1505 (2.2%)	69 / 1499 (4.6%)
Other	1 / 1505 (0.1%)	1 / 1499 (0.1%)
Elapsed Times - minutes, median (IQR) [N]		
EMS arrival to start of first airway attempt	9.8 (7.0, 13.2) [1122]	12.5 (9.0, 16.8) [1038]
EMS arrival to successful or abandoned airway insertion	10.6 (7.7, 14.0) [1200]	13.4 (9.8, 17.8) [1038]
Start of first airway attempt to successful or abandoned airway insertion	0.5 (0.0, 1.0) [1092]	0.9 (0.0, 1.1) [952]
Rescue airway interventions, n / N [%]		
Endotracheal tube	62 / 159 (39.0%)	62 / 573 (10.8%)
Laryngeal tube	44 / 159 (27.7%)	433 / 573 (75.6%)
Other	2 / 159 (1.3%)	7 / 573 (1.2%)
None (bag-valve-mask only)	51 / 159 (32.1%)	71 / 573 (12.4%)
Transported to Emergency Department, n / N [%]	906 / 1505 (60.2%)	889 / 1499 (59.3%)
Arrived at Emergency Department with advanced airway in place, n / N [%]		
Yes	751 / 904 (83.1%)	703 / 884 (79.5%)
No	153 / 904 (16.9%)	181 / 884 (20.5%)
Emergency Department airway management, n / N [%]		
Maintained use of out-of-hospital endotracheal tube	53 / 749 (7.1%)	358 / 700 (51.1%)
Maintained use of out-of-hospital laryngeal tube	207 / 749 (27.6%)	100 / 700 (14.3%)
Maintained use of other out-of-hospital airway	2 / 749 (0.3%)	1 / 700 (0.1%)
Insertion of endotracheal tube in Emergency Department	482 / 749 (64.4%)	232 / 700 (33.1%)
Insertion of laryngeal tube in Emergency Department	5 / 749 (0.7%)	6 / 700 (0.9%)
Other	0 / 749 (0.0%)	3 / 700 (0.4%)

EMS=Emergency Medical Services. ALS=Advanced Life Support. BLS=Basic Life Support.

eTable 4. Characteristics of Subjects Receiving Bag-Valve-Mask (BVM) Ventilation Only

Characteristic	Intervention Group (Laryngeal Tube)	Control Group (Endotracheal Tube)
	N=152	N=200
Age, years - median (IQR)	65 (48, 75)	62 (49, 75)
Male, n / N [%]	82 / 152 [53.9%]	121 / 200 [60.5%]
Witnessed Arrest, n / N [%]		
EMS Witnessed	37 / 138 [26.8%]	33 / 189 [17.5%]
Bystander Witnessed	50 / 138 [36.2%]	71 / 189 [37.6%]
Not Witnessed	51 / 138 [37.0%]	85 / 189 [45.0%]
Unknown[1]	14 / 152 [9.2%]	11 / 200 [5.5%]
Bystander chest compressions, n / N [%]		
Yes	67 / 111 [60.4%]	95 / 163 [58.3%]
No	44 / 111 [39.6%]	68 / 163 [41.7%]
Unknown[1]	41 / 152 [27.0%]	37 / 200 [18.5%]
Time from dispatch to first arrival of EMS[1]		
Minutes – median (IQR)	4.9 (4.0, 6.3)	5.4 (4.3, 7.1)
≤4 minutes, n / N [%]	39 / 145 [26.9%]	34 / 176 [19.3%]
Unknown[1]	7 / 152 [4.6%]	24 / 200 [12.0%]
First rhythm		
Shockable	50 / 152 [32.9%]	56 / 200 [28.0%]
Non-shockable	91 / 152 [59.9%]	137 / 200 [68.5%]
Other	11 / 152 [7.2%]	7 / 200 [3.5%]
Reasons for use of bag-valve-mask only		
Patient regained consciousness	53 [34.9%]	50 [25.0%]
Patient died before airway attempt	19 [12.5%]	31 [15.5%]
Jaw clenched	23 [15.1%]	19 [9.5%]
Adequate ventilation with bag-valve-mask	13 [8.6%]	22 [11.0%]
Arrived at Emergency Department before airway attempt	13 [8.6%]	14 [7.0%]
Unable to determine[1]	20 [13.1%]	45 [22.5%]
Other	12 [7.9%]	19 [9.5%]

[1] For “unknown” values, denominator is total cases in group.

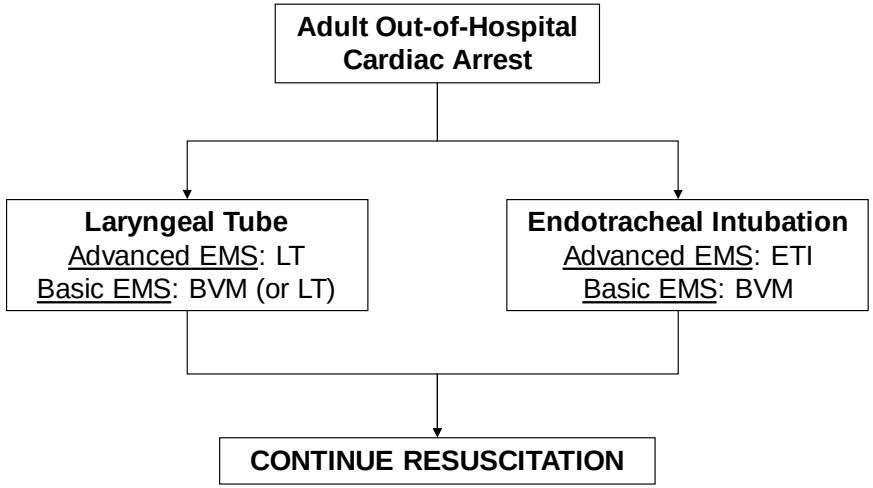
eTable 5. As-Treated Analysis

The as-treated analysis accounts for three potential outcomes for the initial and overall airway management efforts: a) laryngeal tube, b) endotracheal intubation or c) bag-valve-mask or other airway device. Final airway attempted represents the last reported airway attempted in the out-of-hospital setting. LT = laryngeal tube. ETI = endotracheal intubation.

As-Treated Analysis	72-Hour Survival n / N [%]	Difference (95% CI) LT vs ETI[1]	p-value LT vs. ETI
Initial Airway Attempted			
Endotracheal Tube	165 / 1224 [13.5%]	2.5% (-0.2%, 5.2%)	0.07
Laryngeal Tube	227 / 1423 [16.0%]		
Bag-valve-mask only or other airway device	113 / 353 [32.0%]		
Final Airway Attempted			
Endotracheal Tube	98 / 709 [13.8%]	1.4% (-1.6%, 4.4%)	0.37
Laryngeal Tube	265 / 1744 [15.2%]		
Bag-valve-mask only or other airway device	142 / 547 [26.0%]		

[1] Two-way comparisons limited to LT vs. ETI only.

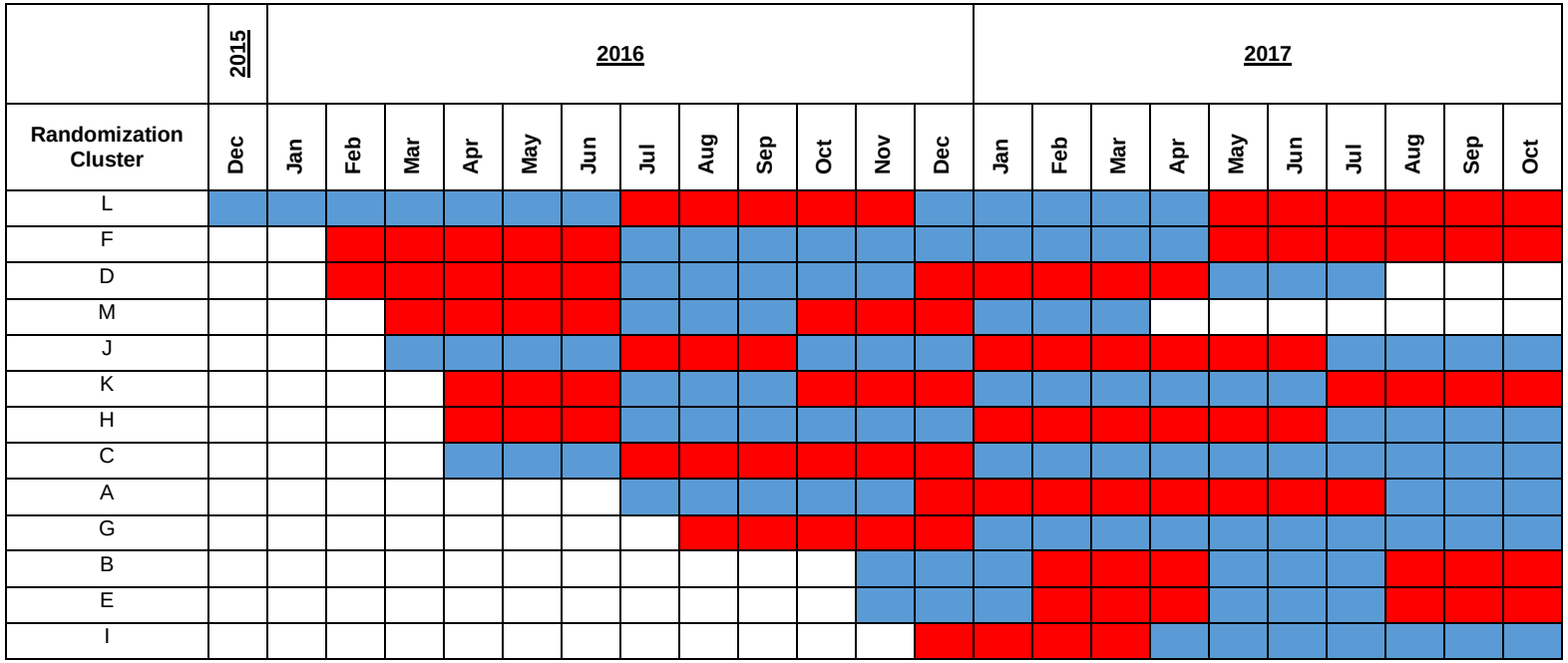
eFigure 1. Overview of Trial Protocol



ETI = endotracheal intubation. LT = laryngeal tube. BVM = bag-valve-mask ventilation. EMS = Emergency Medical Services.

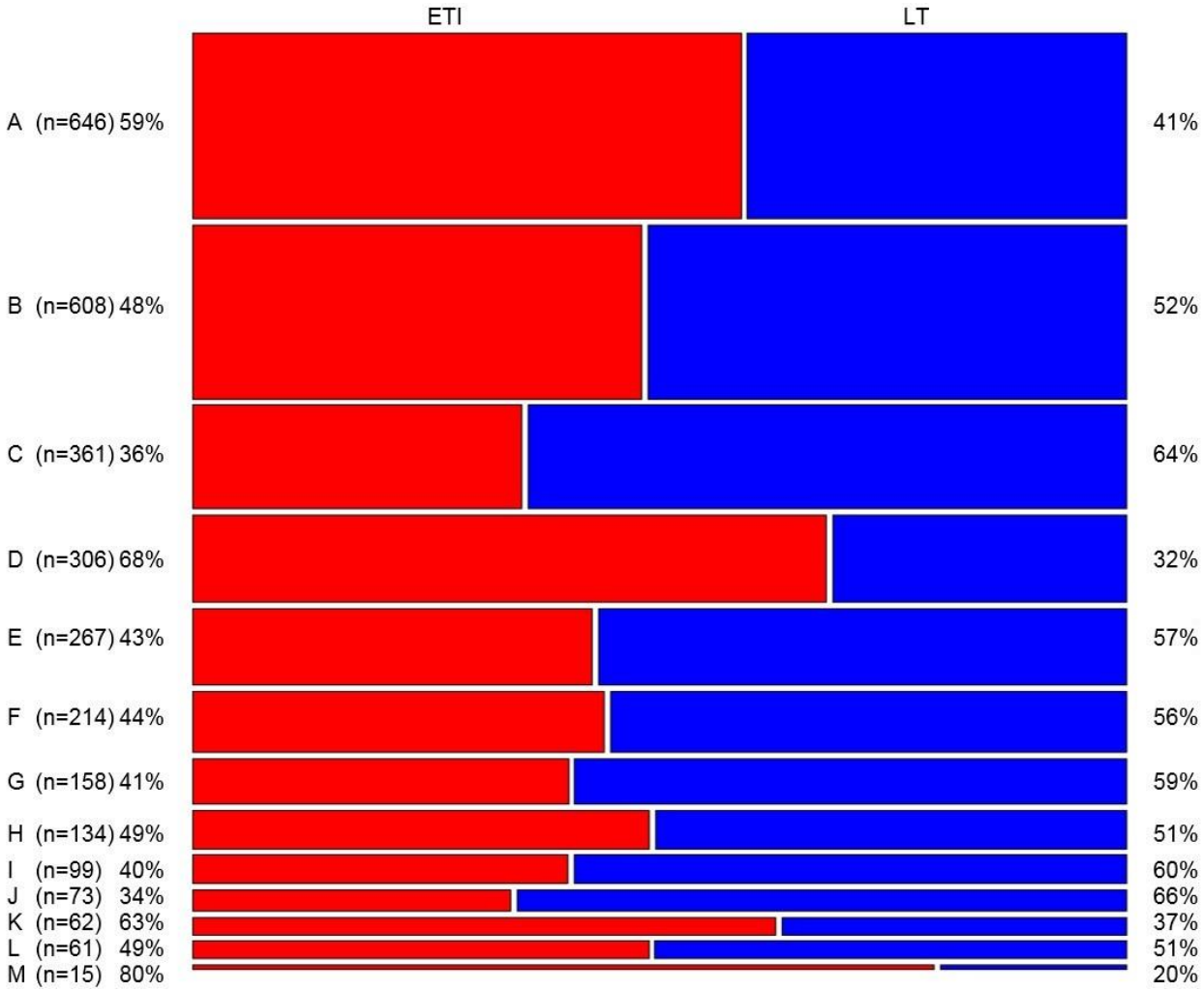
eFigure 2. Timing of EMS Agency Enrollment And Treatment Crossovers in the Trial

Clusters listed in order of initial enrollment month. Letters correspond to randomization clusters depicted in Appendix 9. Blue = LT. Red = ETI.



eFigure 3. Mosaic Plot Depicting Proportion of Patients Enrolled in Each Study Group, Stratified by Randomization Cluster

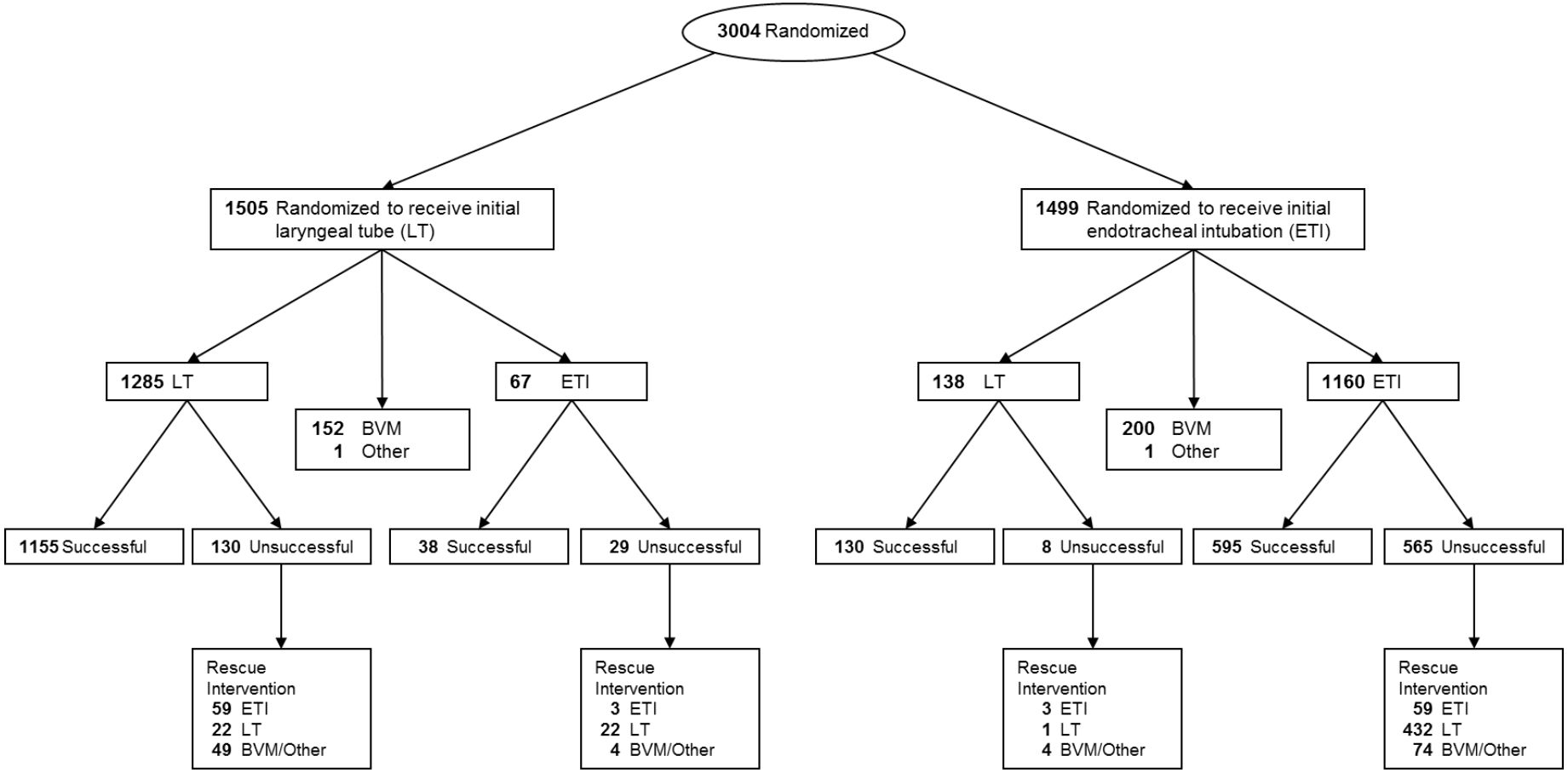
Vertical height of each bar reflects the proportion of total subjects in the randomization cluster. Percentages to the left and right of the bars reflect proportions of ETI and LT patients enrolled in each randomization cluster.



ETI = endotracheal intubation. LT = laryngeal tube.

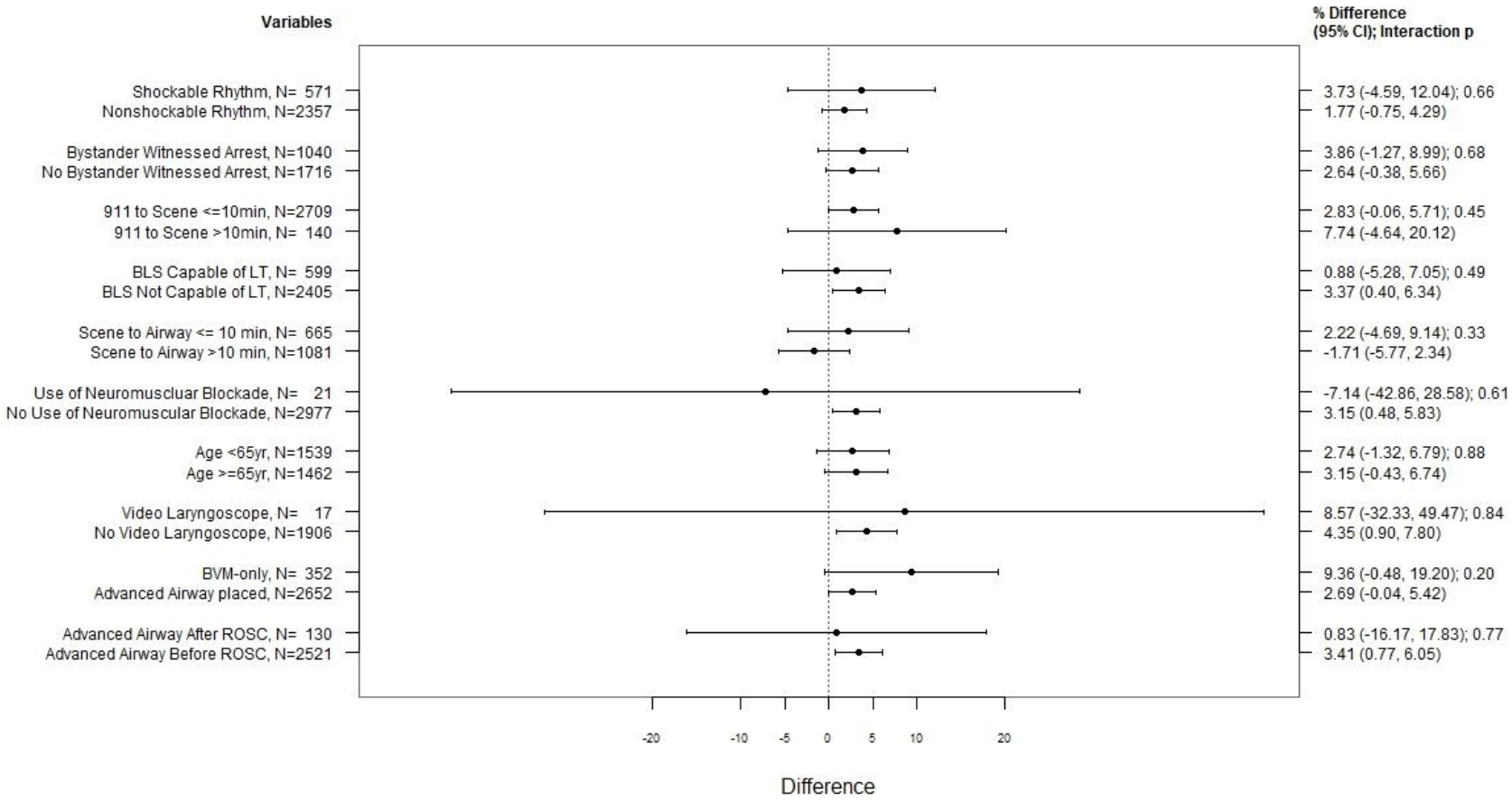
eFigure 4. Results of Advanced Airway Insertion Efforts

LT = laryngeal tube, BVM = bag-valve-mask, ETI = endotracheal intubation.



eFigure 5. Differences (%) in 72-Hour Survival Between LT and ETI in *A Priori* Defined Subgroups

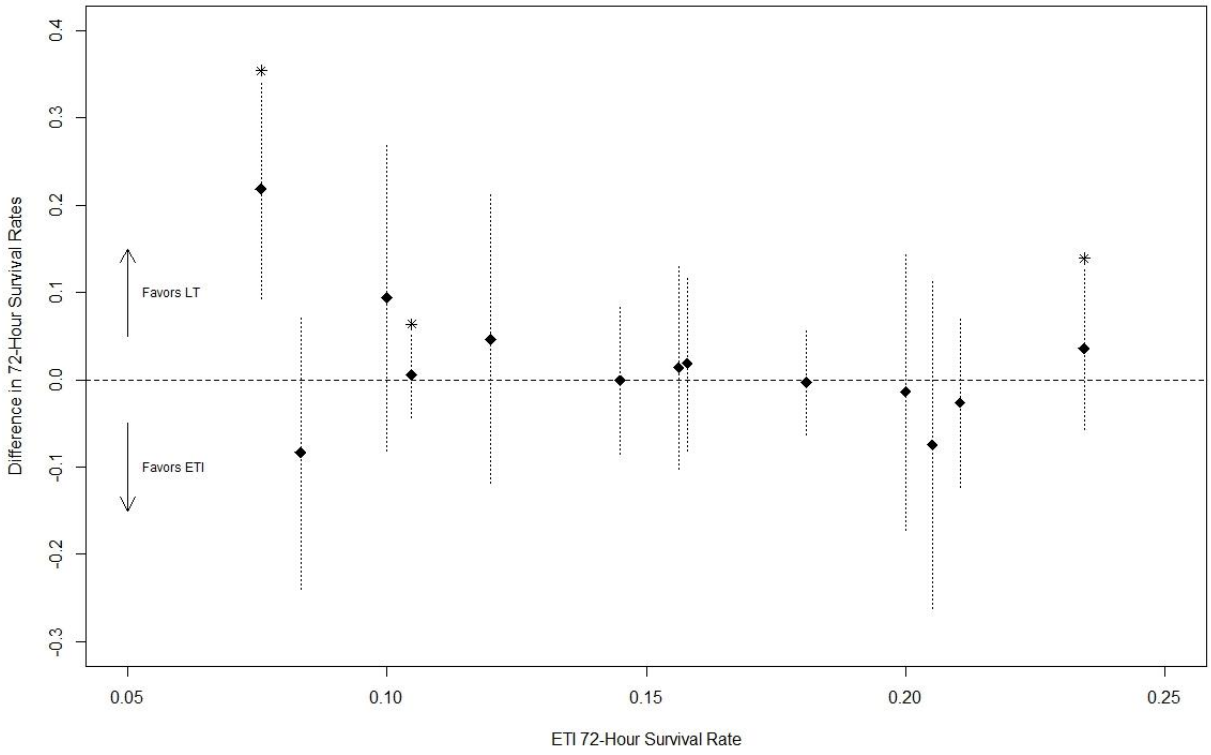
Points to right favor LT. Points to left favor ETI. Five (5) EMS agencies had access to neuromuscular blocking agents.



eFigure 6. Variations in 72-Hour Survival Across Randomization Clusters

Y-axis depicts difference in 72-hour survival between LT and ETI. X-axis depicts the baseline cluster 72-hour survival rate. Bars reflect differences in 72-hour survival and 95% confidence intervals. Results based upon *post hoc* analyses. [Cluster X Treatment] interaction p=0.32.

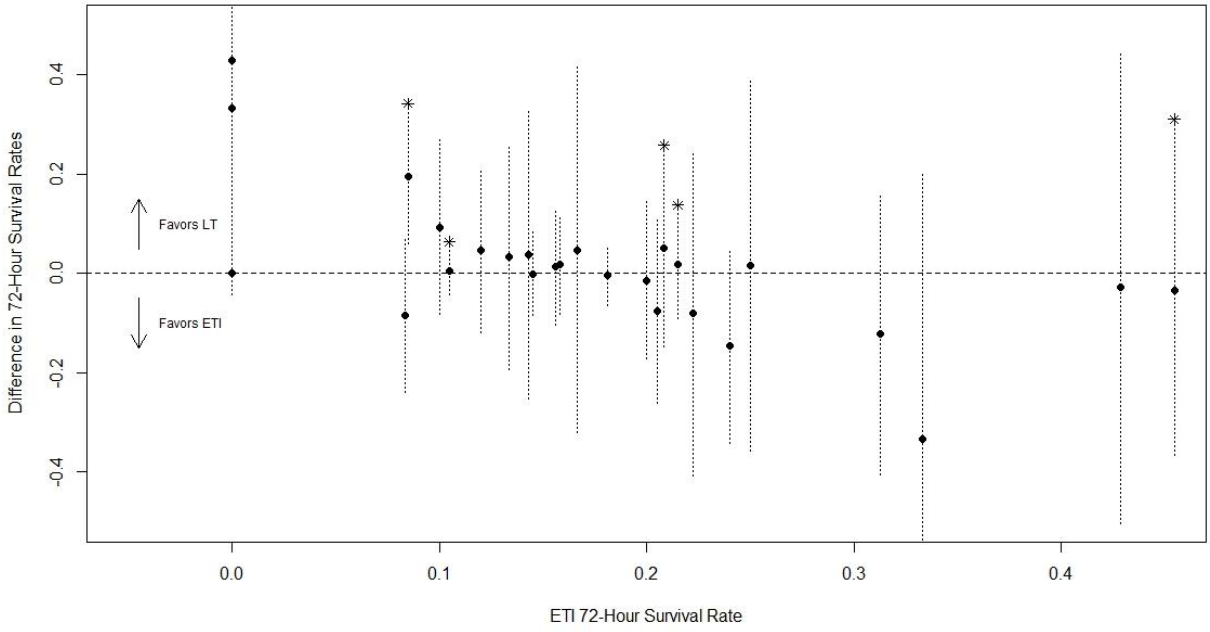
* Denotes clusters in which EMS agencies had access to neuromuscular blocking agents.



eFigure 7. Variations in 72-Hour Survival Across EMS Agencies

Y-axis depicts difference in 72-hour survival between LT and ETI. X-axis depicts the baseline agency 72-hour survival rate. Bars reflect differences in 72-hour survival and 95% confidence intervals. Results based upon *post hoc* analyses. [Agency X Treatment] interaction p=0.59.

* Denotes clusters in which EMS agencies had access to neuromuscular blocking agents.



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Baylor Scott & White Medical Center, Sunnyvale, TX
Dallas Regional Medical Center, Mesquite, TX
John Peter Smith Hospital, Fort Worth, TX
Las Colinas Medical Center, Irving, TX
Medical City Plano, Plano, TX
Medical City Plaza, Fort Worth, TX
Medical City North Hills, North Richland Hills, TX
Medical City Alliance, Fort Worth, TX
Methodist Richardson Medical Center, Richardson, TX
Texas Health Resources Harris Methodist, Ft. Worth, TX
Texas Health Resources Alliance, Fort Worth, TX

Texas Health Resources Arlington Memorial, Arlington, TX
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Hospital PIs and Coordinators; Jon Thammavong, Research Coordinator for Baylor Scott & White Dallas; John Garrett, MD, PI for Baylor Scott & White Hospitals; Mark Gamber, MD, PI for Medical City Plano; Mini Delashaw, MD, PI for all other Medical City Hospitals; Rajesh Gandhi, MD, PI for John Peter Smith Hospital; Lawrence Hum, MD, PI for all THR hospitals

Milwaukee Regional Coordinating Center

Resuscitation Research Center, Tom P. Aufderheide, MD, MS, Melissa Mena BS CCRC, Jacob Labinski BA CCRC, Jamie Jasti MS, Caroline Herdeman BA CCRC, Jasmine Balangue BS, Laura Tonyan MS RRT, Linda M Mattrisch BS EMT-P, Carolyn Heal MS, Danielle Sparrow MA, Adam Drent MA, Amanda Emmrich MS CCRC, Igli Arapi MS, Disha Chheda MSc, Rachel Weber BS, Mitchell Sauder BS, Lisa Martin BA,

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Cudahy Fire Department, Cudahy, WI; Dan Mayer, Chief; Jeff Bloor, Battalion Chief.

Franklin Fire Department, Franklin, WI; Adam Remington, Chief; Patrick Hays, Assistant Chief

Greendale Fire Department, Greendale, WI; Tim Saidler, Chief; Mike Schmitt, Captain.

Greenfield Fire Department, Greenfield, WI; Jon Cohn, Chief; Dan Weber, Battalion Chief.

Hales Corners Fire Department, Hales Corners, WI; Mike Jankowski, Chief; Zach Menden, Captain.

City of Milwaukee Fire Department, Milwaukee, WI; Mark Rohlfing, Chief; Steve Riegg, Deputy Chief.

North Shore Fire Department, Brown Deer, WI; Robert Whitaker, Chief; Toby Carlson, Battalion Chief; Dan Tyk, Lieutenant.

Oak Creek Fire Department, Oak Creek, WI; Tom Rosandich, Chief; Michael Kressuk, Assistant Chief; Michael Havey, Assistant Chief.

St. Francis Fire Department, St Francis, WI; Nick Poplar, Interim Chief; Michael Buckhalter, Captain.

South Milwaukee Fire Department, South Milwaukee, WI; Joseph Knitter, Chief; Glen McCoy, Captain; Kurt Egner, Lieutenant.

Wauwatosa Fire Department, Wauwatosa, WI; Robert Ugaste, Chief; Stacey Lueptow, Deputy Chief; Chris Sandoval, Battalion Chief.

West Allis Fire Department, West Allis, WI; Mason Pooler, Interim Chief; Kurt Zellmann, Assistant Chief.

Mitchell International Airport Fire Department, Milwaukee, WI; Joseph A. Forro, Chief; Terry Czajkowski, Assistant Chief.

128th Air Refueling Wing Fire and Emergency Department, Milwaukee, WI; John Reichel, Chief; John Charlier, Deputy Chief; Jeremy Espil, EMS Operations Manager.

Hospitals:
Aurora St. Luke's Medical Center, Milwaukee, WI: Randall S. Lambrecht, PhD, Thomas Rudek, MD
Aurora Sinai Medical Center, Milwaukee, WI: Paul Coogan, MD
Aurora St. Luke's South Shore, Cudahy, WI: Erik Almeida, MD, Thomas Rudek, MD
Aurora West Allis Medical Center, West Allis, WI: Sean Nolan, MD

Columbia St. Mary's Hospital Milwaukee, Milwaukee, WI: Richard J Shimp, MD
Columbia St. Mary's Hospital Ozaukee, Mequon, WI: Michael Brin, DO, MPH
Froedtert Hospital & the Medical College of Wisconsin, Wauwatosa, WI: Stephen W. Hargarten, MD, MPH
Community Memorial Hospital, Menomonee Falls, WI: Dennis Shepherd, MD
St. Joseph's Hospital, Milwaukee, WI: Gary Swart, MD
Elmbrook Memorial Hospital, Brookfield, WI: Gary Swart, MD
Franklin Hospital, Franklin, WI: Neal A. Harmelink, MD, Gary Swart, MD
St. Francis Hospital, Milwaukee, WI: Gary Swart, MD

Pittsburgh Regional Coordinating Center

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UPMC Prehospital Care Program; Curtis Neill.

Medical Rescue Team South Authority; John Moses, Todd Pritchard, Jesse Siefert, Douglas Widmer.

Scott Township EMS; Scott Cavey, Tom Salerno Jr.

Tri Community South EMS; Maureen Evans, Timothy Hall, Nora Helfrich.

St. Clair Hospital; Micha Campbell, MD; Venard Campbell; Kristen Seaman, MD;

Hospitals:
St. Clair Hospital, St. Clair, PA: Owen Traynor MD.
Jefferson Hospital, Jefferson Hills, PA

Portland Regional Coordinating Center

Mohamud Daya, MD, Site PI; Denise Griffiths; Matthew Hansen, MD; Michael Kampp, MD; Nancy Le; Rahill Mirlohi; Jack Nuttall; Edgardo Peteros, Jr; Dana Zive.

Clackamas County Fire District 1, Clackamas, OR; William Conway (EMS Chief); Deidre Toczyski; Mike Verkest; Craig Warden, MD.

Hillsboro Fire Department, Hillsboro, OR**;** Catherine Amerson; Amanda Pedroza; Anne Raven; Michael Shertz MD

Lake Oswego Fire Department, Lake Oswego, OR; Steven Dehart; Ritu Sahni, MD; Gert Zoutendijk.

Metro West Ambulance, Portland, OR; Larry Boxman, Matthew McCoy MD; Ritu Sahni, MD; Shawn Wood

Skamania County EMS, Stevenson, WA; Greg Hoskins, MD; Lynn Wittwer, MD; Brian Wood.

Tualatin Valley Fire & Rescue, Tigard, OR; Dana Alteneder; Mohamud Daya, MD; David Dennis; Matthew Hansen MD; William Steward; Scott Sullivan; Brent VanKeulen, EMS Chief.

Hospitals:
Legacy Meridian Park Hospital; Cameron Klug, MD, Hospital PI; Karla Kummer;
Kaiser Sunnyside and Westside Hospitals; Christina Carlson; Ryan Radecki MD, Hospital PI; Samantha Sahnow.
PeaceHealth Soutwest Medical Center, Clark County, WA
Providence Milwaukie Hospital, Milwaukie, OR
Providence Newberg Hospital, Newberg, OR
Providence St. Vincent Hospital, Portland, OR
Providence Willamette Falls Hospital, Oregon City, OR
Tuality Community Hospital, Hillsboro, OR

University of Washington Clinical Trials Center

Judy Powell, Michelle Doyle, Jonas Carson, Ben Bergsten-Buret, Winnie Kirdpoo, Brian Leroux, David Prince.