1. Hubble MW, Taylor S, Martin M, Houston S, Kaplan GR, Kearns RD. Intraosseous route is associated with prolonged epinephrine-to-ROSC interval in out-of-hospital cardiac arrest. Ir J Med Sci. 2025 Jun 21. doi: 10.1007/s11845-025-03979-4. Epub ahead of print. PMID: 40542909.

The objective of this study was to describe the relationship between the route of first epinephrine administration and the pressor-to-ROSC interval. A retrospective analysis of the 2020 ESO Data Collaborative dataset was conducted among adult, non-traumatic, bystander-witnessed OHCA patients. A Cox proportional hazards model was used to evaluate the association between epinephrine route and time to ROSC. Among 9,351 patients (mean age 65.3 years; 63.9% male), ROSC was achieved in 39.7%. The mean pressor-to-ROSC interval was 13.2 minutes for IV, 14.9 minutes for tibial IO, and 14.4 minutes for humeral IO administration ($p < 0.001$). Tibial and humeral IO routes were associated with decreased hazard of ROSC compared to IV (HR 0.78 and 0.86, respectively).

2. Harmon, I., Brailsford, J., Sanchez-Cano, I., & Fishe, J. (2024). Development of a Computable Phenotype for Prehospital Pediatric Asthma Encounters. Prehospital Emergency Care, 29(1), 10–21. https://doi.org/10.1080/10903127.2024.2352583

The objective of this study was to develop a prehospital-specific computable phenotype (CP) to identify pediatric asthma exacerbations. A retrospective observational study was conducted using ESO data from 2018–2021 for patients aged 2–18 years. Two existing rule-based CPs were modified, and three new CPs (one rule-based, two machine learning-based) were created. Physician-labeled encounters were split into training, validation, and test sets. Among 24,283 encounters, the best-performing model was a multi-layer perceptron, with F1 score 0.95, specificity 1.00, sensitivity 0.91, PPV 1.00, and NPV 0.98.

3. Bongiorno DM, Peters GA, Samuels-Kalow ME, et al. Racial and Ethnic Disparities in EMS Use of Restraints and Sedation for Patients With Behavioral Health Emergencies. JAMA Netw Open. 2025;8(3):e251281. doi:10.1001/jamanetworkopen.2025.1281

The objective of this study was to evaluate racial disparities in the use of chemical and physical restraints by EMS during behavioral health emergencies. Researchers used the 2021 ESO Data Collaborative dataset to conduct a retrospective cohort analysis of adult EMS encounters involving behavioral complaints. Logistic regression models adjusted for demographic and clinical variables were used to assess associations between race and restraint use. Findings showed that Black patients had significantly higher odds of receiving any restraint and/or sedation (aOR 1.17) and physical (aOR 1.22) restraints compared to White patients.

4. Broad A, Luo X, Tahabi FM, Abdoo D, Zhang Z, Adelgais K. Factors associated with abusive head trauma in young children presenting to emergency medical services using a large language model. Prehospital Emergency Care. 2025;29(3):227–237. doi: 10.1080/10903127.2025.2451200

The objective of this research was to identify factors associated with abusive head trauma (AHT) in young children using EMS data and a large language model (LLM). The study used the ESO Data Collaborative to retrospectively analyze EMS records for children under five years of age with head trauma. A transformer-based LLM was developed to extract clinical features from EMS narratives, which were then used in multivariable logistic regression models to evaluate associations with confirmed AHT. Among 3,846 pediatric head trauma cases, 1,203 (31.3%) were classified as AHT. Features such as altered mental status, apnea, and caregiver concern were significantly associated with AHT.

5. Harrison J, Bhardwaj A, Houck O, Sather K, Sekiya A, Knack S, Saarunya Clarke G, Puskarich MA, Tignanelli C, Rogers L, Marmor S, Beilman G. Emergency medical services level of training is

associated with mortality in trauma patients: A combined prehospital and in hospital database analysis. J Trauma Acute Care Surg. 2025 Mar 1;98(3):402-409. doi: 10.1097/TA.0000000000004540. Epub 2025 Jan 9. PMID: 39786151; PMCID: PMC11902590.

The objective of this study was to evaluate the association between EMS provider level and mortality in trauma patients. A secondary analysis was conducted using ESO data from 2018–2022, including ground-transported patients aged 15–100 years with trauma-specific ICD-10-CM codes. Patients dead on EMS arrival or transferred from another facility were excluded. Propensity score matching (1:1 nearest neighbor) was used to control for demographic, injury, EMS, and trauma center characteristics. Among 1,154 matched ALS and BLS patient pairs, ALS transport was associated with lower mortality (OR 0.40; 95% CI: 0.18–0.88; p = 0.023). Subgroup analyses showed similar associations in patients >50 years (OR 0.35; 95% CI: 0.13–0.98) and in non-fall mechanisms of injury (OR 0.35; 95% CI: 0.13–0.98). The association approached significance in patients with prehospital time >30 minutes (OR 0.30; 95% CI: 0.08–1.08).

6. Cheek L, Schmicker RH, Crowe R, Goren E, West A, McMullan J, Raelson C, Poole J, Adams K, Hoering A, Myers B, Nichol G. Rurality and Area Deprivation and Outcomes After Out-of-Hospital Cardiac Arrest. JAMA Netw Open. 2025 Apr 1;8(4):e253435. doi: 10.1001/jamanetworkopen.2025.3435. PMID: 40232722; PMCID: PMC12000968.

The objective of this study was to assess whether neighborhood rurality or economic deprivation is associated with EMS outcomes after OHCA. This cohort study used ESO data from 2022–2023 for adult patients (≥18 years) with nontraumatic OHCA receiving chest compressions or defibrillation. Rurality and deprivation were assessed using Rural-Urban Commuting Area codes and the Area Deprivation Index, respectively, and grouped by EMS agency. Among 162,289 patients (median age 66 years; 62.3% male), ROSC at ED arrival occurred in 23.7%. Compared to urban areas with low deprivation, rural areas with high (AOR 0.81; 95% CI: 0.72–0.91), moderate (AOR 0.75; 95% CI: 0.70–0.81), or low deprivation (AOR 0.74; 95% CI: 0.62–0.88) had lower odds of ROSC. Among patients with linked hospital data, urban areas with high or moderate deprivation had lower odds of survival (AOR 0.78; 95% CI: 0.68–0.90 and AOR 0.82; 95% CI: 0.75–0.89) and favorable discharge destination (AOR 0.65; 95% CI: 0.53–0.79 and AOR 0.77; 95% CI: 0.69–0.87).

7. Cash RE, Crowe RP, Swanton M, Boggs KM, Goldberg SA, Sullivan AF, Camargo CA, Zachrison KS. Creation of a Novel National Dataset Through Linkage of Emergency Medical Services (EMS) Transport Destination and Verified Emergency Department (ED) Capability. Prehosp Emerg Care. 2025 Mar 12:1-6. doi: 10.1080/10903127.2025.2470286. Epub ahead of print. PMID: 39982213.

The objective of this study was to link EMS transport destinations with verified ED capability data to support evaluation of prehospital routing practices. Researchers linked the 2021 ESO Data Collaborative with the 2021 National Emergency Department Inventory (NEDI)-USA, which includes verified trauma, stroke, and burn center designations for all nonfederal, non-specialty EDs open 24/7/365. EMS destinations labeled as “hospital” were matched to NEDI-eligible EDs using a three-step process: exact name/address match, probabilistic matching, and manual review. Of 9,420 EMS-identified hospital destinations, 2,714 (29%) were non-hospital or ineligible facilities. Among the remaining 6,706 destinations, 98% (n = 6,605) were successfully linked to NEDI-USA EDs, representing 3,877 unique EDs in 49 states and covering 68% of EDs in the NEDI-USA database.

8. Jarvis J, Jarvis S, Kennel, J. The Association Between Out-of-Hospital Drug-Assisted Airway Management Approach and Intubation First-Pass Success. Annals of Emergency Medicine

The objective of this study was to determine the association between out-of-hospital drug-assisted airway management approach and first-pass success. Using a national EMS dataset, researchers conducted an observational analysis of 12,713 non-cardiac arrest patients who underwent at least one intubation attempt during a 911 response. Drug-assisted airway management approaches were

categorized as rapid sequence intubation (RSI), sedation-only, paralytic-only, or no medications. RSI was used in 51.2% of cases, no medications in 29.6%, sedation-only in 17.9%, and paralytic-only in 1.3%. Overall first-pass success was 75.1%. Compared to no medications, RSI (aOR 2.23; 95% CI: 2.00–2.50) and paralytic-only (aOR 2.11; 95% CI: 1.38–3.24) were associated with higher odds of first-pass success, while sedation-only was not (aOR 1.04; 95% CI: 0.92–1.19). RSI was also associated with higher first-pass success compared to sedation-only (aOR 2.14; 95% CI: 1.88–2.43).

9. **McInnis RP, Wood AJ, Shay CL, Haggart AA, Crowe RP, Guterman EL. Dispatch Decisions and Emergency Medical Services Response in the Prehospital Care of Status Epilepticus. West J Emerg Med. 2025 May 18;26(3):549-555. doi: 10.5811/westjem.21266. PMID: 40562000; PMCID: PMC12208027.**

The objective of this study was to evaluate how emergency medical dispatch (EMD) identifies status epilepticus (SE) and influences EMS resource allocation. A cross-sectional analysis was conducted using 2019 ESO Data Collaborative data for adult patients (≥18 years) with an EMS impression of SE and no cardiac arrest. Among 18,515 encounters with an EMD code, 75% were dispatched as seizures/convulsions and 25% as other conditions. Of those dispatched as seizures/convulsions, 46.4% were designated high acuity and 63.6% low acuity. Most received emergent ambulance responses (98.1% high acuity; 81.8% low acuity) and ALS-trained responders (93.7% high acuity; 92.7% low acuity). Median response times were similar across acuity levels.

10. **Smida T, Crowe R, Price BS, Scheidler J, Martin PS, Shukis M, Bardes J. A retrospective 'target trial emulation' comparing amiodarone and lidocaine for adult out-of-hospital cardiac arrest resuscitation. Resuscitation. 2025 Jan 23:110515. doi: 10.1016/j.resuscitation.2025.110515. Epub ahead of print. PMID: 39863130.**

The objective of this research was to use 'target trial emulation' methodology to compare the outcomes of patients who received amiodarone or lidocaine during resuscitation. Adult, non-traumatic OHCA patients in the ESO Data Collaborative 2018-2023 datasets who experienced OHCA prior to EMS arrival, presented with a shockable rhythm, and received amiodarone or lidocaine during resuscitation were evaluated for inclusion. We used propensity score matching (PSM) to investigate the association between antiarrhythmic and outcomes. Return of spontaneous circulation (ROSC) was the primary outcome. Secondary outcomes included the number of post-drug defibrillations and survival to hospital discharge. After application of exclusion criteria, 23,263 patients from 1,707 EMS agencies were eligible for analysis. Prior to PSM, 6,010/20,284 (29.6%) of the patients who received amiodarone and 1,071/2,979 (35.9%) of the patients who received lidocaine achieved prehospital ROSC. Following PSM, lidocaine administration was associated with greater odds of prehospital ROSC (36.0 vs. 30.4%; aOR: 1.29 [1.16, 1.44], n = 2,976 matched pairs). Lidocaine administration was also associated with fewer post-drug defibrillations (median: 2 [0-4] vs. 2 [0-6], mean: 3.3 vs. 3.9, $p < 0.01$, n = 2,976 pairs), and greater odds of survival to discharge (35.1 vs. 25.7%; OR: 1.54 [1.19, 2.00], n = 538 pairs). These results suggest that lidocaine was associated with greater odds of prehospital ROSC in comparison to amiodarone when administered during resuscitation from shock refractory or recurrent VF/VT.

11. **Smida T, Cheskes S, Crowe R, Price BS, Scheidler J, Shukis M, Martin PS, Bardes J. The association between initial defibrillation dose and outcomes following adult out-of-hospital cardiac arrest resuscitation: A retrospective, multi-agency study. Resuscitation. 2025 Jan 23:110507. doi: 10.1016/j.resuscitation.2025.110507. Epub ahead of print. PMID: 39855423.**

The aim of this study was to explore the association between initial defibrillation dose and outcome following OHCA using the ESO Data Collaborative (2018-2022). The study population for this retrospective study was adult (18-80 years of age) non-traumatic OHCA patients who presented with an initially shockable ECG rhythm. Patients with ROSC prior to initial defibrillation, a resuscitation-limiting advanced directive, or were residents in a healthcare institution were excluded. The primary exposure was initial defibrillation dose, defined as Joules per kilogram of body weight, and the primary outcome was return of spontaneous circulation (ROSC). Survival to discharge was included as a secondary outcome. Multivariable logistic regression modeling was used to assess the

relationship between defibrillation dose and outcome. Data from 21,121 patients were analyzed. Of the 12,160 patients linked to a defibrillator manufacturer, 7,240 (59.5%) were treated using a biphasic truncated exponential (BTE) waveform and 4,920 (40.5%) were treated using a rectilinear biphasic (RLB) waveform. Defibrillation dose (per 1 J/kg increase) was not associated with ROSC (BTE aOR: 0.97 [0.92, 1.01], n = 7,240; RLB aOR: 1.00 [0.92, 1.09], n = 4,920; all aOR: 1.01 [0.98, 1.04], 21,121) or survival (BTE aOR: 0.98 [0.87, 1.10], n = 1,245; RLB aOR: 0.89 [0.70, 1.12], n = 775; all aOR: 1.00 [0.92, 1.08], n = 2,981). Initial defibrillation dose was not associated with outcome in this nationwide cohort.

12. **Alison Treichel, Remle P. Crowe, Antonio R. Fernandez, Scott S. Bourn, Brent J. Myers. Trends in EMS encounters and outcomes among children and adolescents with firearm injuries from 2018 to 2022, The American Journal of Emergency Medicine, Volume 90, 2025, Pages 55-60, ISSN 0735-6757, https://doi.org/10.1016/j.ajem.2024.12.069.**

The objective of this research was to describe changes in patient and encounter characteristics among EMS responses for patients ages 0–19 with firearm-related injuries. This retrospective national analysis used data from the 2018–2022 ESO Data Collaborative and included all 9-1-1 records for patients ages 0–19 years with documentation of firearm-related injuries. Percent changes were reported; annual changes were evaluated using a non-parametric test of trend. Among 7913 total EMS encounters from 586 agencies, median age was 16 years and 82% were male. 9-1-1 call volume increased 8% over the study period while firearm injuries increased by 79% (p-trend<0.01), peaking in 2021 (*n* = 2036). Assault was the most documented intent category across all years (86 % total increase). Black and Hispanic patients experienced the largest percent increase (86 %, 110 %). Most encounters occurred in communities of the greatest socioeconomic vulnerability (57 %). Overall, 10 % of patients died on-scene; among those transported with outcome data (*n* = 1514), 9 % died.

13. **Wagstaff HM, Crowe RP, Youngquist ST, Stoecklein HH, Treichel A, He Y, Majersik JJ. Numerical Cincinnati Stroke Scale Versus Stroke Severity Screening Tools for the Prehospital Determination of Large Vessel Occlusion. Prehosp Emerg Care. 2025 Jan 23:1-8. doi: 10.1080/10903127.2024.2430442. Epub ahead of print. PMID: 39561317.**

This study aimed to compare numerical CPSS to additional stroke scales using a national emergency medical services (EMS) database using the 2022 ESO Data Collaborative dataset. Prehospital CPSS was compared to the C-STAT, the FAST-ED, and the BE-FAST. The optimal prediction cut points for LVO screening were determined by intersecting the sensitivity and specificity curves for each scale. Discriminative abilities of each scale among those diagnosed with LVO were compared using the AUROC. 17,442 prehospital records were identified from 754 EMS agencies with ≥1 documented stroke scale of interest: 30.3% (*n* = 5,278) had a hospital diagnosis of stroke, of which 71.6% (*n* = 3,781) were ischemic; of those, 21.6% (*n* = 817) were diagnosed with LVO. CPSS score ≥2 was found to be predictive of LVO with 76.9% sensitivity, 68.0% specificity, and AUROC 0.787 (95%CI 0.722-0.801). All other tools had similar predictive abilities, with sensitivity/specificity/AUROC of: C-STAT 62.5%/76.5%/0.727 (0.555-0.899); FAST-ED 61.4%/76.1%/0.780 (0.725-0.836); BE-FAST 70.4%/67.1%/0.739 (0.697-0.788). The less complex CPSS exhibited comparable performance to three frequently employed LVO detection tools.

14. **Ramgopal S, Kemal S, Attridge MM, Crowe R, Martin-Gill C, Macy ML. Comparison of Neighborhood Disadvantage Indices on Emergency Medical Services Interventions and Outcomes for Pediatric Out-of-Hospital Emergencies. Acad Pediatr. 2024 Oct 11:102592. doi: 10.1016/j.acap.2024.10.004. Epub ahead of print. PMID: 39396570.**

The aim of this research was to compare differing indices of neighborhood disadvantage with emergency medical services (EMS) interventions in children. A retrospective study of EMS encounters for children (<18 years) from approximately 2000 US EMS agencies between 2021 and 2022 was conducted. Exposures were the Child Opportunity Index (COI; v2.0), 2021 Area Deprivation Index (ADI), and 2018 Social Vulnerability Index (SVI). The agreement in how children were classified with each index using the intraclass correlation coefficient was evaluated. Logistic regression to

evaluate the association of each index with transport status, presence of cardiac arrest, and condition-specific interventions and assessments was conducted. Ultimately, 738,892 encounters were included in the study. The correlation between the indices indicated good agreement (intraclass correlation coefficient=0.75). There was overlap in relationships between the COI, ADI, and SVI for each of the study outcomes, both when visualized as a splined predictor and when using representative odds ratios (OR) comparing the third quartile of each index to the lower quartile (most disadvantaged).

15. **Hubble MW, Taylor S, Martin M, Houston S, Kaplan GR. Optimal weight-based epinephrine dosing for patients with a low likelihood of survival following out-of-hospital cardiac arrest. Ir J Med Sci. 2024 Aug 27. doi: 10.1007/s11845-024-03797-0. Epub ahead of print. PMID: 39190288.**

The objective of this research was to identify an optimal weight-based epinephrine dose for return-of-spontaneous-circulation (ROSC) after a single bolus among patients with low likelihood of survival. Included were adult patients who experienced a witnessed, non-traumatic out-of-hospital cardiac arrest prior to EMS arrival. Patients with shockable presenting rhythms or receiving bystander CPR were excluded. The AUROC was used to assess the predictive value of epinephrine dose (mg/kg) for ROSC following a single bolus. From the ROC curve, the optimal threshold dosage (OTD) was determined using the Youden Index. A logistic regression model calculated the adjusted odds ratio of OTD on ROSC. A total of 2,463 patients met inclusion criteria, of which 190 (7.7%) attained ROSC after the first epinephrine administration. The dosage AUROC for ROSC was 0.603 ($p < 0.01$). As calculated by the Youden index, the OTD was 0.013 mg/kg. Patients receiving ≥ OTD were more likely to attain ROSC after a single epinephrine bolus (OR = 2.25,$p < 0.001$).

16. **Hubble MW, Martin MD, Kaplan GR, Houston SE, Taylor SE. The Route to ROSC: Evaluating the Impact of Route and Timing of Epinephrine Administration in Out-of-Hospital Cardiac Arrest Outcomes. Prehosp Emerg Care. 2024 Oct 14:1-9. doi: 10.1080/10903127.2024.2414389. Epub ahead of print. PMID: 39374012.**

The aim of this research was to determine the association between first epinephrine route and return of spontaneous circulation (ROSC) while controlling for resuscitation time bias and other potential confounders. A retrospective analysis using the 2020 ESO Data Collaborative dataset was conducted; Adult patients with a witnessed, non-traumatic OHCA prior to EMS arrival were included. Logistic regression was used to determine the association between medication route and ROSC. Linear regression was then used to calculate the probability of ROSC for each route across all call receipt-to-drug delivery intervals. Using these linear equations, the call receipt-to-drug delivery intervals were calculated that would yield equivalent probabilities of ROSC between the IV and IO routes. Data were available for 10,350 patients, of which 27.4% presented with a shockable rhythm, 29.7% received bystander CPR, and 39.6% experienced ROSC. After controlling for confounders, IO epinephrine was associated with decreased likelihood of ROSC (OR = 0.77, $p < 0.001$). The linear regression models provided differing slope coefficients for ROSC between each route, with the IV route associated with a higher likelihood of ROSC for any given call receipt-to-drug-delivery interval. From these equations, the additional time allowed to establish an IV and administer epinephrine intravenously beyond the time required for IO delivery, yet with an equivalent predicted probability of ROSC via the IO route, was calculated. This additional time interval for intravenous administration declined linearly from 9 min at a call receipt-to-intraosseous epinephrine interval of 4 min to no additional time at a call receipt-to-intraosseous epinephrine interval of 29 min.

17. **Smida T, Voges L, Crowe R, Scheidler J, Bardes J. Prehospital Transcutaneous Cardiac Pacing in the United States: Treatment Epidemiology, Predictors of Treatment Failure, and Associated Outcomes. Prehosp Emerg Care. 2024 Sep 4:1-8. doi: 10.1080/10903127.2024.2393768. Epub ahead of print. PMID: 39150824.**

The objective of this study was to examine the outcomes of patients who received prehospital TCP and identify predictors of TCP failure. All patients without a documented TCP attempt were excluded. Mortality was derived from hospital disposition data. TCP failure was defined as the initiation of CPR following the first TCP attempt among patients who did not receive CPR prior to the first TCP attempt. Multivariable logistic regression models using age and sex as covariables were used to explore the

association between prehospital vital signs and TCP failure. During the study period, 13,270 patients received transcutaneous pacing and 2560 of these patients had outcome data available. Overall, the mortality rate following TCP was 63.4%. Among patients who did not receive CPR prior to the first TCP attempt (n = 7930), TCP failure (progression to cardiac arrest) occurred 20.4% of the time. Factors associated with TCP failure included increased body weight (>100 vs. 60-100 kg, aOR: 1.33 (1.15, 1.55)), a pre-pacing non-bradycardic heart rate (>50 vs. <40 bpm, aOR: 2.87 (2.39, 3.44)), and pre-TCP hypoxia (<80% vs. >90% SpO2, aOR: 6.01 (4.96, 7.29)).

18. **Finney JD, Schuler PD, Rudloff JR, Agostin N, Lobanov OV, Siegler J, Shah MI, Guterman EL, Chamberlain JM, Ahmad FA. Evaluation of the Use of Ketamine in Prehospital Seizure Management: A Retrospective Review of the ESO Database. Prehosp Emerg Care. 2024 Jul 31:1-8. doi: 10.1080/10903127.2024.2382367. Epub ahead of print. PMID: 39058382.**

The objective of this paper was to describe EMS use of ketamine for seizure management. A retrospective review of 9-1-1 EMS encounters with a primary or secondary impression of seizure using the ESO Data Collaborative from 2018 to 2021 was performed. Encounters during which ketamine was administered were isolated, excluding medication administrations prior to EMS arrival and encounters without medication administration. Subgroup analysis was performed to control for airway procedure as an indication for ketamine administration. Co-administration with other antiseizure medications, dose and route of administration, and response to treatment were also analyzed. 99,576 encounters met inclusion criteria. There were 2,531/99,576 (2.54%) encounters with ketamine administration and 50.7% (1,283/2,531) received ketamine without an airway procedure. There were 616 cases (48%, 616/1,283) where ketamine was given without another antiseizure medication (ASM) and without any airway procedure. The remaining 667 (52%) cases received ketamine with at least one other ASM, most commonly midazolam (89%, 593/667). Adjusted for the growth in the ESO dataset, ketamine use by EMS professionals during encounters for seizures without an airway procedure increased from 0.90% (139/15,375) to 1.45% (416/28,651) an increase of 62% over the study period.

19. **Smida T, Price BS, Mizener A, Crowe RP, Bardes JM. Prehospital Post-Resuscitation Vital Sign Phenotypes are Associated with Outcomes Following Out-of-Hospital Cardiac Arrest. Prehosp Emerg Care. 2024 Aug 15:1-8. doi: 10.1080/10903127.2024.2386445. Epub ahead of print. PMID: 39088816.**

The aim of this study was to use k-means clustering to identify post-ROSC vital sign clusters and determine whether these clusters were associated with rearrest and mortality. The ESO Data Collaborative 2018-2022 datasets were used for this study. We included adult, non-traumatic OHCA patients with >2 post-ROSC vital sign sets. Patients were excluded if they had an EMS-witnessed OHCA or were encountered during an interfacility transfer. Unsupervised (k-means) clustering was performed using minimum, maximum, and delta (last minus first) systolic blood pressure (BP), heart rate, SpO2, shock index, and pulse pressure. The assessed outcomes were mortality and rearrest. To explore the association between rearrest, mortality, and cluster, multivariable logistic regression modeling was used. Within the identified cohort of 12,320 patients, five clusters were identified. Patients in cluster 1 were hypertensive, patients in cluster 2 were normotensive, patients in cluster 3 were hypotensive and tachycardic (n = 2164; 17.6%), patients in cluster 4 were hypoxemic and exhibited increasing systolic BP, and patients in cluster 5 were severely hypoxemic and exhibited a declining systolic BP. The overall proportion of patients who experienced mortality stratified by cluster was 63.4% (c1), 68.1% (c2), 78.8% (c3), 84.8% (c4), and 86.6% (c5). In comparison to the cluster with the lowest mortality (c1), each other cluster was associated with greater odds of mortality and rearrest.

20. **Hubble MW, Kaplan GR, Martin M. Influence of patient body weight on the probability of return of spontaneous circulation following out-of-hospital cardiac arrest: an exploratory analysis. Br Paramed J. 2024 Sep 1;9(2):11-20. doi: 10.29045/14784726.2024.9.9.2.11. PMID: 39246831; PMCID: PMC11376325.**

The objective of this study was to assess the relationship between patient weight and return of spontaneous circulation (ROSC) during OHCA. This retrospective study included adult patients from a

national emergency medical services (EMS) patient record, with witnessed, non-traumatic OHCA prior to EMS arrival from January to December 2020. Logistic regression was used to evaluate the relationship between patient weight and ROSC. Complete records were available for 9096 patients. Altogether, 81.8% of arrests were of presumed cardiac etiology and 30.3% presented with a shockable rhythm. ROSC was less likely with patient weight >100 kg (OR = 0.709, p <0.001), male sex (OR = 0.782, p <0.001), and increasing age and EMS response time (OR = 0.994 per year, p <0.001 and OR = 0.970 per minute, p <0.001, respectively). Although the mean first adrenaline dose (mg/kg) followed a downward trend due to its non-weight-based dosing scheme, the mean total adrenaline dose administered to achieve ROSC demonstrated an upward linear trend of 0.05 mg for every 5 kg of body weight.

21. **Hubble, M. W., Martin, M., Houston, S., Taylor, S., & Kaplan, G. R. (2024). Influence of Patient Weight on Prehospital Advanced Airway Procedure Success Rates. Prehospital Emergency Care, 1–8. https://doi.org/10.1080/10903127.2024.2338459**

A retrospective analysis using the 2020 ESO Data Collaborative dataset was conducted to evaluate the relationship between patient weight and problematic airway intervention. The inclusion criteria consisted of adult patients weighing >30kg with an attempted orotracheal intubation (OTI) and/or blind insertion airway device (BIAD) placement. Separate logistic regression models were developed to determine the influence of weight (dichotomized at 100 kg) on cumulative procedure success for OTI and BIAD, and linear regression models were used to identify trends for each across weight strata. A total of 45,344 patients met inclusionary criteria. OTI was attempted in 18,153(40.0%) patients, while 21,597(47.6%) had a BIAD attempt and 5,594(12.3%) had both airway types attempted. The overall cumulative insertion success rates for OTI and BIAD were 79.5% and 92.7%, respectively. Altogether, 2,711(6.0%) had no advanced airway of any type successfully placed, which represents the overall failed advanced airway rate. After controlling for patient age, sex, minority status, and call type (medical vs. trauma), weight >100kg was associated with decreased likelihood of cumulative OTI success (OR = 0.64, p < 0.001), but higher likelihood of cumulative BIAD success (OR = 1.31, p < 0.001). Cumulative OTI success was associated with a negative 0.6% linear trend per 5 kg of body weight (p < 0.001) while cumulative BIAD success had a 0.2% positive trend (p < 0.001).

22. **Wang HE, Yu MI, Crowe RP, et al. Longitudinal Changes in Emergency Medical Services Advanced Airway Management. JAMA Netw Open. 2024;7(8):e2427763. doi:10.1001/jamanetworkopen.2024.27763**

The objective of this study was to examine the longitudinal trends in endotracheal intubation (ETI) and supraglottic airway (SGA) utilization in a national EMS cohort. This retrospective cross-sectional study analyzed 2011 to 2022 data from the ESO Data Collaborative, a national database of US prehospital electronic health records. The study included all 911 EMS events in which advanced airway management was attempted. Data were analyzed from November 2022 to January 2024. Among 47.5 million EMS activations, 444 041 (mean [SD] age, 60.6 [19.8] years; 273 296 [61.5%] men) involved advanced airway management, including 305 584 (68.8%) that used ETI and 200 437 (45.1%) that used SGA. The overall incidence was 9.3 per 1000 EMS events. In the cardiac arrest cohort from 2011 to 2022, EMS events with ETI attempts decreased from 2470 of 2831 (87.3%) to 40 083 of 72 793 (55.1%) and those with SGA attempts increased from 711 of 2831 (25.1%) to 44 386 of 72 793 (61.0%). In the pediatric subset, there were similarly large decreases in ETI attempts, from 117 of 182 EMS events (97.3%) to 1573 of 2307 EMS events (68.2%), and increases in SGA attempts, from 11 of 182 EMS events (6.6%) to 1058 of 2307 EMS events (45.9%). In the nonarrest medical and nonarrest trauma cohorts, ETI attempts decreased and SGA attempts increased but to a much lower extent.

23. **Kaduce, Michael & Fernandez, Antonio & Bourn, Scott & Calhoun, Dustin & Williams, Jefferson & DeLuca, Mallory & Abraham, Heidi & Uhl, Kevin & Bregenzer, Brian & Larmon, Baxter & Crowe, Remle & Myers, J.. (2024). Perceptions and Use of Automated Hospital Outcome Data by EMS Providers: A Pilot Study. Western Journal of Emergency Medicine. 10.5811/WESTJEM.21175.**

The primary objective was to evaluate the perception of emergency medical service providers' review of automated hospital outcome data. Secondarily, participation in outcome review as a

means of microlearning to obtain continuing education (CE) was assessed. From October–December 2023, three high-volume EMS systems participated in a three-part intervention with results evaluated using a mixed-methods approach. First, EMS providers (emergency medical technicians and paramedics) were invited, via their electronic health record (EHR), to complete a presurvey evaluating their perceptions of reviewing outcomes. EMS providers were invited to complete a post-survey mirroring the pre-survey. Qualitative analyses identified themes among open-ended responses. Quantitative analyses examined perceptions between pre- and post- surveys. Of 843 providers contacted, 217 responded to the pre-survey (25.7%). The most endorsed rationale for reviewing outcomes included improving clinical knowledge (95%), improving patient care (94%), and knowing whether care made a difference (93%). Among the 67 who completed the open-ended items, the three dominant themes included enhance personal confidence and competence (43%); acquire personal knowledge (39%); and operations (21%). A total of 152 providers responded to the post-survey, and the percentage who agreed that reviewing outcomes improves job satisfaction rose from 89% to 95% between pre- and post-surveys (P = 0.05).

24. **Tanner Smida, Remle Crowe, Patrick Merrill, James Scheider. A Simpler Method for Choosing Adult i-gel Size: An Evaluation of Real-World Prehospital Data, 2024. Air Medical Journal. https://doi.org/10.1016/j.amj.2024.03.011**

The study objective was to compare a sex-based i-gel size selection strategy with a weight-based strategy using real-world prehospital data. The ESO Data Collaborative 2018 to 2022 dataset was used. All initial i-gel insertion attempts in patients > 18 years of age were evaluated for inclusion. Insertion attempts were excluded if age, sex, weight, success, or device size was not documented. Logistic regression was used to compare the rate of insertion failure on the first attempt for the group placed in alignment with the weight-based but not sex-based method with the group placed in alignment with the sex-based but not weight-based method. After the application of the exclusion criteria, 39,867 initial i-gel insertion attempts were included. The overall rate of failure was 6.5% (2,585/39,867). The rate of unsuccessful i-gel placement was similar when i-gel devices were placed in alignment with a sex-based size selection method in comparison to i-gel placement in alignment with a weight-based selection strategy (6.0% vs. 6.4%). Logistic regression analysis did not reveal a significant difference between groups (odds ratio: 1.08; 95% confidence interval: 0.95-1.23). The use of a sex-based method of i-gel size selection may be equivalent with respect to the rate of unsuccessful i-gel placement on the first attempt in comparison to a weight-based method.

25. **Johnson, K., & Ward, C. (2024). Factors Associated with Caregiver Decision Not to Transport Pediatric Patients Assessed by Emergency Medical Services. International Journal of Paramedicine, (6), 83–97. https://doi.org/10.56068/EMRN2070**

This study's objective was to explore the non-transport decisions. We conducted a retrospective cross-sectional study with data from the national 2019 ESO Data Collaborative (a convenience sample with data from > 2,000 EMS agencies). We included 9-1-1 responses for children <18 years. The primary outcome was caregiver decision not to transport patient (per EMS documentation) compared to EMS-initiated non-transport. Descriptive data for patient dispositions were generated. Bivariable and multivariable logistic regression identified factors associated with caregiver decision not to transport. Of 313,903 pediatric 9-1-1 activations, 37.2% resulted in non-transport, with 80.0% of pediatric non-transports attributable to a caregiver decision. The patient and encounter characteristics for children not transported by EMS were similar, regardless of whether the caregiver or EMS clinician made the decision not to transport. There was wide inter-agency variation in both the rate of non-transport (median 0.37, interquartile range (IQR 0.25 – 0.48)) and the proportion of these encounters attributable to a caregiver decision (median 0.82, IQR 0.68-0.94). Further research is needed to understand pediatric patient outcomes after non-transport and to identify the reasons for practice variability between EMS agencies.

26. **Ramgopal S, Crowe RP, Jaeger L, Fishe J, Macy ML, Martin-Gill C. Measures of Patient Acuity Among Children Encountered by Emergency Medical Services by the Child Opportunity Index.**

Prehosp Emerg Care. 2024 Apr 10:1-9. doi: 10.1080/10903127.2024.2333493. Epub ahead of print. PMID: 38517514.

This study evaluated differences in prehospital care among children by the Child Opportunity Index (COI), the agreement between a child's COI at the scene and at home, and in-hospital outcomes for children by COI. We performed a retrospective study of pediatric (<18 years) scene encounters from approximately 2,000 United States EMS agencies from the 2021-2022 ESO Data Collaborative. We evaluated socioeconomic status using the multi-dimensional COI v2.0 at the scene. We described EMS interventions and in-hospital outcomes by COI categories using ordinal regression. We evaluated the agreement between the home and scene COI. Children from lower COI areas more frequently had a response occurring at home (62.9% in Very Low COI areas; 47.1% in Very High COI areas). Children from higher COI areas were more frequently not transported to the hospital (odds ratio [OR] 0.87, 95% confidence interval [CI] 0.86-0.87). Children in lower COI areas had lower use of physical (OR 1.23, 95% CI 1.13-1.33) and chemical (OR 1.41, 95% CI 1.29-1.55) restraints for behavioral health problems. Among injured children with elevated pain scores (≥7), analgesia was provided more frequently to children in higher COI areas (OR 1.73, 95% CI 1.65-1.81). The proportion of children in cardiac arrest was lowest from higher COI areas. Among 107,114 encounters with in-hospital data, the odds of hospitalization was higher among children from higher COI areas (OR 1.14, 95% CI 1.11-1.18) and was lower for in-hospital mortality (OR 0.75, 95% CI 0.65-0.85). Home and scene COI had a strong agreement (Kendall's W = 0.81).

27. Tanner Smida, Remle Crowe, P.S. Martin, James Scheidler, Bradley Price, James Bardes. A retrospective, multi-agency 'target trial emulation' for the comparison of post-resuscitation epinephrine to norepinephrine. Resuscitation, 2024 https://doi.org/10.1016/j.resuscitation.2024.110201.

The aim of this study was to compare the rates of rearrest and mortality between OHCA patients receiving vasopressors in the prehospital setting. Adult (18–80 years of age) non-traumatic OHCA patients in the 2018–2022 ESO Data Collaborative datasets with a documented post-ROSC norepinephrine or epinephrine infusion were included in this study. Logistic regression modeling was used to evaluate the association between vasopressor agent and outcome using two sets of covariables. Overall, 1,893 patients treated by 309 EMS agencies were eligible for analysis. 1,010 (53.4%) received an epinephrine infusion and 883 (46.7%) received a norepinephrine infusion as their initial vasopressor. Adjusted analyses did not discover an association between vasopressor agent and rearrest (aOR: 0.93 [0.72, 1.21]) or mortality (aOR: 1.00 [0.59, 1.69]). In this multi-agency target trial emulation, the use of a post-resuscitation epinephrine infusion was not associated with increased odds of rearrest in comparison to the use of a norepinephrine infusion.

28. Christopher R. Wyatt, Lawrence H. Brown. Outcomes in hypothermic cardiac arrest without evidence of abrupt cooling. The American Journal of Emergency Medicine, 2024. ISSN 0735-6757, https://doi.org/10.1016/j.ajem.2024.03.016.

In this analysis, we compared outcomes among OOHCA patients with and without hypothermia transported to the emergency department (ED) by emergency medical services (EMS), but without a history suggesting abrupt cooling. We used 2019–2022 data from the ESO Data Collaborative. We identified all patients who received prehospital chest compressions, were transported to the ED, and who also had ED or hospital diagnosis data available. We then determined whether each patient had an ED or hospital diagnosis of "accidental hypothermia" (ICD-10 "T68.x" or ICD-9 "991.6"). We compared outcomes for hypothermic and non-hypothermic patients using proportions with 95% confidence intervals, as well as chi-square analysis, at three sequential timepoints: arrival at the ED (i.e., any return of spontaneous circulation (ROSC) prior to ED arrival), ED disposition (i.e., survival to hospital admission), and hospital disposition (i.e., survival to hospital discharge). We also constructed multivariable logistic regression models for each outcome, adjusting for age, sex, witnessed arrest, and presenting rhythm. Finally, we conducted two sensitivity analyses: (1) limiting our definition of hypothermia to only ED-assigned diagnoses to exclude any cases of in-hospital

hypothermia following resuscitation; and (2) since diagnosis coding practices may vary by hospital, limiting the analysis to only those hospitals that reported a hypothermia ICD code for at least one OOHCA patient. Hypothermic patients were younger, more likely to have a non-cardiac arrest etiology, and less likely to present with a shockable initial rhythm, but hypothermic and non-hypothermic patients had similar rates of bystander CPR and similar EMS on-scene times. After adjusting for age, sex, witnessed arrest, arrest etiology and presenting rhythm, hypothermic patients remained more likely to achieve ROSC (aOR: 2.9 [CI: 2.2–3.8]) and survive to hospital admission (aOR 3.6 [CI: 2.5–5.1]), but not to survive to hospital discharge (aOR: 1.3 [CI: 0.9–1.7]). The results of our sensitivity analyses did not meaningfully differ from those of our primary analysis (see supplemental appendix).

29. **Ramgopal S, Owusu-Ansah S, Crowe RP, Okubo M, Martin-Gill C. Association of midazolam route of administration and need for recurrent dosing among children with seizures cared for by emergency medical services. Epilepsia. 2024 Mar 12. doi: 10.1111/epi.17940. Epub ahead of print. PMID: 38470335.**

This study evaluated the association of route of midazolam administration with the use of additional benzodiazepine doses for children with seizures cared for by emergency medical services (EMS). We conducted a retrospective cohort study from a US multiagency EMS dataset for the years 2018-2022, including children transported to the hospital with a clinician impression of seizures, convulsions, or status epilepticus, and who received an initial correct weight-based dose of midazolam (.2 mg/kg intramuscular, .1 mg/kg intravenous, .2 mg/kg intranasal). We evaluated the association of route of initial midazolam administration with provision of additional benzodiazepine dose in logistic regression models adjusted for age, vital signs, pulse oximetry, level of consciousness, and time spent with the patient. The median time to the first dose of midazolam from EMS arrival was similar between children who received intramuscular (7.3 min, interquartile range [IQR] = 4.6-12.5) and intranasal midazolam (7.8 min, IQR = 4.5-13.4) and longer for intravenous midazolam (13.1 min, IQR = 8.2-19.4). At least one additional dose of midazolam was given to 21.4%. In multivariable models, intranasal midazolam was associated with higher odds (odds ratio [OR] = 1.39, 95% confidence interval [CI] = 1.10-1.76) and intravenous midazolam was associated with similar odds (OR = 1.00, 95% CI = .80-1.26) of requiring additional doses of benzodiazepines relative to intramuscular midazolam.

30. **Smida T, Crowe R, Jarvis J, Ratcliff T, Goebel M. Retrospective Comparison of Upper and Lower Extremity Intraosseous Access During Out-of-Hospital Cardiac Arrest Resuscitation. Prehosp Emerg Care. 2024 Mar 26:1-8. doi: 10.1080/10903127.2024.2321285. Epub ahead of print. PMID: 38416867.**

This study aimed to compare the outcomes of OHCA patients who received upper or lower extremity IO access during resuscitation. The ESO Data Collaborative public use research datasets were used for this retrospective study. All adult (≥18 years of age) OHCA patients with successful IO access in an upper or lower extremity were evaluated for inclusion. Patients were excluded if they had intravenous (IV) access prior to IO access, or if they had a Do Not Resuscitate order documented. Our primary outcome was return of spontaneous circulation (ROSC). Secondary outcomes included survival to discharge and survival to discharge to home. Mixed-effects multivariable logistic regression models adjusted for age, sex, etiology, witnessed status, pre-first responder cardiopulmonary resuscitation (CPR), initial electrocardiogram (ECG) rhythm, location [private/residential, public, or assisted living/institutional], and response time in addition to the primary airway management strategy (endotracheal intubation, supraglottic device, surgical airway, no advanced airway) were used to compare the outcomes of patients with upper extremity IO access to the outcomes of patients with lower extremity IO access. Upper extremity IO access was associated with greater adjusted odds of ROSC (1.11 [1.08, 1.15]), and this finding was consistent across multiple patient subgroups. Secondary analyses suggested that upper extremity access was associated with increased survival to discharge (1.18 [1.00, 1.39]) and survival to discharge to home (1.23 [1.02, 1.48]) in comparison to lower extremity IO access.

31. **Ramgopal S, Naik VV, Komukai S, Owusu-Ansah S, Crowe RP, Okubo M, Martin-Gill C. The association of prehospital systemic corticosteroids with emergency department and in-hospital outcomes for patients with asthma exacerbations. Acad Emerg Med. 2024 Mar 8. doi: 10.1111/acem.14890. Epub ahead of print. PMID: 38456349.**

The aim of this research was to examine factors associated with prehospital corticosteroid administration with hospitalization and hospital length of stay (LOS). We performed a retrospective study of EMS encounters for patients 2-50 years of age with suspected asthma exacerbation from a national data set. We evaluated factors associated with systemic corticosteroid administration using generalized estimating equations. We performed propensity matching based on service level, age, encounter duration, vital signs, and treatments to evaluate the association of prehospital corticosteroid administration with hospitalization and LOS using weighted logistic regression. We evaluated the association of prehospital corticosteroid administration with admission using Bayesian models. Administration of corticosteroids was associated with older age; sex; urbanicity; advanced life support provider; vital sign instability; increasing doses of albuterol; and provision of ipratropium bromide, magnesium, epinephrine, and supplementary oxygen. Within the matched sample, prehospital corticosteroids were not associated with hospitalization (odds ratio [OR] 0.86, 95% confidence interval [CI] 0.73-1.01) or LOS (multiplier 0.76, 95% CI 0.56-1.05). Administration of corticosteroids was associated with lower odds of admission and shorter LOS in longer EMS encounters (>34 min), lower admission odds in patients with documented wheezing, and shorter LOS among patients treated with albuterol. In a Bayesian model with noninformative priors, the OR for admission among encounters given corticosteroids was 0.86 (95% credible interval 0.77-0.96).

32. **Fornage LB, O'Neil C, Dowker SR, Wanta ER, Lewis RS, Brown LH. Prehospital Intervention Improves Outcomes for Patients Presenting in Atrial Fibrillation with Rapid Ventricular Response. Prehosp Emerg Care. 2023 Nov 17:1-10. doi: 10.1080/10903127.2023.2283885. Epub ahead of print. PMID: 37975632.**

The aim of this study was To compare outcomes of patients presenting to emergency medical services (EMS) with atrial fibrillation with rapid ventricular response (AF-RVR) who did and did not receive prehospital advanced life support (ALS) rate or rhythm control intervention(s). This retrospective cohort study used the 2021 ESO Data Collaborative (Austin, TX) dataset. We identified 9-1-1 scene responses for patients aged 16 to 100 years old presenting with AF and an initial heart rate ≥ 110 beats per minute (bpm). Prehospital ALS interventions for AF-RVR included medications (e.g., calcium channel blockers, beta blockers, etc.) or electrical cardioversion. Outcome measures included prehospital rate control (i.e., final prehospital heart rate < 110 bpm), emergency department (ED) discharge to home, ED and hospital length of stay, and mortality. We also evaluated prehospital adverse events-specifically bradycardia, hypotension, and cardiac arrest. We used propensity score matching to compare outcomes among treated and untreated patients with similar demographic and clinical characteristics. We determined the average treatment effect on the treated (ATET) with 95% confidence intervals (CI) and the number needed to treat (NNT). Prehospital rate control was more frequent for treated than for untreated patients (41.0% vs. 18.2%, ATET +22.8%, CI: +21.1%; +24.6%, NNT = 5). Hospital outcomes were available for 1,347 treated patients matched with 1,347 similar untreated patients. Treated patients were more likely to be discharged from the ED (37.9% vs. 34.0%, ATET +3.9%, CI: +0.2%; +7.5%, NNT = 26) and less likely to die (4.3% vs. 6.7%, ATET -2.5%, CI: -4.2%; -0.8%, NNT = 40) compared to untreated patients. Hypotension occurred more often in treated patients (ATET +2.6%, CI: +1.5%; +3.7%), but resolved before ED arrival in 73% of affected patients. Otherwise, adverse event rates did not significantly differ for the two groups.

33. **Jordan Thomas, Remle Crowe, Kevin Schulz, Henry E. Wang, Marcia C. De Oliveira Otto, Bejamin Karfunkle, Eric Boerwinkle, Ryan Huebinger. Association Between Emergency Medical Service**

Agency Intubation Rate and Intubation Success, Annals of Emergency Medicine,2024,,ISSN 0196-0644,https://doi.org/10.1016/j.annemergmed.2023.11.005.

The objective of this study was to evaluate the association between agency intubation attempt rate and intubation success using a national out-of-hospital database. We conducted a retrospective secondary analysis of the ESO Data Collaborative from 2018 to 2019, and included all adult cases with an endotracheal intubation attempt. We calculated the number of intubations attempted per 100 responses, advanced life support responses, and transports for each agency. We excluded cases originating at health care facilities and outliers. We used multivariable logistic regression to evaluate the association between agency intubation attempt rate and 1) intubation success and 2) first-pass success. Overall, the intubation success rate was 78.8%, and the first-pass success rate was 68.5%. Per agency, the median rate of intubation attempts per 100 emergency medical service responses was 0.8 (interquartile range 0.6 to 1.1). Rates of intubation attempts per 100 responses (adjusted odds ratio [aOR] 1.7; 95% confidence interval [CI] 1.6 to 1.8), advanced life support responses (aOR 1.18; 95% CI 1.16 to 1.20), and transports (aOR 1.21; 95% CI 1.18 to 1.22) were all associated with intubation success. These relationships were similar for first-pass success but with smaller effect sizes.

34. Smida T, Menegazzi JJ, Crowe RP, Salcido DD, Bardes J, Myers B. The Association of Prehospital End-Tidal Carbon Dioxide with Survival Following Out-of-Hospital Cardiac Arrest. Prehosp Emerg Care. 2023 Sep 26:1-7. doi: 10.1080/10903127.2023.2262566. Epub ahead of print. PMID: 37751228; PMCID: PMC10963336.

This research aimed to explore the association between ETCO2 and mortality following out-of-hospital cardiac arrest (OHCA). We used the 2018-2021 ESO annual datasets to query all non-traumatic OHCA patients with attempted resuscitation. Patients with documented DNR/POLST, EMS-witnessed arrest, ROSC after bystander CPR only, or < 2 documented ETCO2 values were excluded. The lowest and highest ETCO2 values recorded during the total prehospital interval, in addition to the pre- and post-ROSC intervals for resuscitated patients, were calculated. Multivariable logistic regression models adjusted for age, sex, initial rhythm, witnessed status, bystander CPR, etiology, OHCA location, sodium bicarbonate administration, number of milligrams of epinephrine administered, and response interval were used to evaluate the association between measures of ETCO2 and mortality. Compared to patients with maximum prehospital ETCO2 values of 30-40 mmHg, odds of mortality were increased for patients with maximum prehospital ETCO2 values of <20 mmHg (aOR: 3.5 [2.1, 5,9]), 20-29 mmHg (aOR: 1.5 [1.1, 2.1]), and >50 mmHg (aOR: 1.5 [1.2, 1.8]). After 20 minutes of ETCO2 monitoring, <12% of patients had ETCO2 values <10 mmHg. This cutpoint was 96.7% specific and 6.9% sensitive for mortality.

35. Ramgopal S, Sepanski RJ, Crowe RP, Okubo M, Callaway CW, Martin-Gill C. Correlation of vital sign centiles with in-hospital outcomes among adults encountered by emergency medical services. Acad Emerg Med. 2024; 31: 210-219. doi:10.1111/acem.14821

The objective of this study was to (1) identify empirically derived (unadjusted) cut points for vital signs for adult patients encountered by emergency medical services (EMS), (2) evaluate differences in age-adjusted cutoffs for vital signs in this population, and (3) evaluate unadjusted and age-adjusted vital signs measures with in-hospital outcomes. We used two multiagency EMS data sets to derive (National EMS Information System from 2018) and assess agreement (ESO, Inc., from 2019 to 2021) of vital signs cutoffs among adult EMS encounters. We compared unadjusted to age-adjusted cutoffs. For encounters within the ESO sample that had in-hospital data, we compared the association of unadjusted cutoffs and age-adjusted cutoffs with hospitalization and in-hospital mortality. Both extremely high and extremely low vital signs demonstrated stepwise increases in admission and in-hospital mortality. When evaluating age-based centiles with vital signs, a gradual decline was noted at all extremes of heart rate (HR) with increasing age. Extremes of systolic blood pressure at upper and lower margins were greater in older age groups relative to younger age groups. Respiratory rate (RR) cut points were similar for all adult age groups. Compared to

unadjusted vital signs, age-adjusted vital signs had slightly increased accuracy for HR and RR but lower accuracy for SBP for outcomes of mortality and hospitalization.

36. Smida T, Menegazzi JJ, Crowe RP, Salcido DD, Martin PS, Scheidler J, Bardes J. The Association of Combined Prehospital Hypotension and Hypoxia with Outcomes following Out-of-Hospital Cardiac Arrest Resuscitation. Prehosp Emerg Care. 2023 Aug 9:1-6. doi: 10.1080/10903127.2023.2238820. Epub ahead of print. PMID: 37494278.

The aim of this study was to investigate the association between clinical outcomes and post-resuscitation hypoxia alone, hypotension alone, and combined hypoxia and hypotension. We used the 2018-2021 ESO annual datasets to conduct this study. All EMS-treated non-traumatic OHCA patients who had a documented prehospital return of spontaneous circulation (ROSC) and two or more Sp02 readings and systolic blood pressures recorded were evaluated for inclusion. Patients who were less than 18 years of age, pregnant, had a do-not-resuscitate order or similar, achieved ROSC after bystander CPR only, or had an EMS-witnessed cardiac arrest were excluded. Multivariable logistic regression adjusted for standard Utstein factors and highest prehospital Glasgow Coma Scale (GCS) score was used to investigate the association between hypoxia, hypotension, and outcomes. In this large dataset, hypotension and hypoxia were independently associated with mortality both alone and in combination. Compared to patients without documented hypotension and hypoxia, patients with documented hypotension and hypoxia had nearly five-fold greater odds of mortality. We analyzed data for 17,943 patients, of whom 3,979 had hospital disposition data. Hypotension and hypoxia were not documented in 1,343 (33.8%) patients, 1,144 (28.8%) had only hypoxia documented, 507 (12.7%) had only hypotension documented, and 985 (24.8%) had both hypoxia and hypotension documented. In comparison to patients who did not have documented hypotension or hypoxia, patients who had documented hypoxia (aOR: 1.76 [1.38, 2.24]), documented hypotension (aOR: 3.00 [2.15, 4.18]), and documented hypoxia and hypotension combined (aOR: 4.87 [3.63, 6.53]) had significantly increased mortality. The relationship between mortality and vital sign abnormalities (hypoxia and hypotension > hypotension > hypoxia) was observed in every evaluated subgroup.

37. Fernandez, A.R., Treichel, A., Myers, J.B., Bourn, S.S., Crowe, R.P., & Gardner, B. (2023). Evaluating Firefighter On-Scene Decontamination Practices Using a National Fire Records Management System. Journal of occupational and environmental medicine.

The objective of this study was to describe firefighters' on-scene decontamination procedure use post-working fire and frequency of adherence to best practice. This retrospective analysis of working fires was conducted using records from the ESO Data Collaborative (Austin, TX) national research database from 1/1/2021-12/31/2021. Documentation of decontamination procedures were examined among records with smoke or combustion products exposure. Firefighter and incident characteristics were evaluated. Descriptive statistics and univariable odds ratios were calculated. Fire personnel may not be taking all necessary decontamination steps post-working fires. Among the 31,281 firefighters included in the study, 8.0% documented a fire-related exposure. Of those, 82% performed at least one on-scene decontamination procedure; 4% documented all decontamination procedures defined as best practices. The odds of documenting any decontamination procedure were significantly decreased among firefighters responding to incidents in rural areas compared to urban areas (OR 0.70).

38. Paulina B. Sergot, Loren B. Mead, Elizabeth B. Jones, Remle P. Crowe & Ryan M. Huebinger (2023) Association of Ketamine Dosing with Intubation and Other Adverse Events in Patients with Behavioral Emergencies, Prehospital Emergency Care, DOI: 10.1080/10903127.2023.2234491

The objective of this study was to evaluate the association between prehospital ketamine dosing and rates of intubations and other adverse events in patients with behavioral emergencies. Using the 2018/2019 ESO public-use research datasets, we included all non-traumatic, adult behavioral and

drug-related EMS encounters with ketamine administration. Based on consensus guidelines, we stratified patients into “above” and “at/below” the maximum dosing for sedation (2 mg/kg IV/IO or 5 mg/kg IM) using the highest single dose of ketamine given. We created propensity scores for matched subjects using 1:1 propensity score matching. Using logistic regression, we compared rates of intubation and other airway interventions, antipsychotic coadministration, improvement reported by EMS, hypoxia, hypotension, and cardiac arrest between the two groups. Patients given ketamine doses above consensus recommendations for sedation appeared more likely to receive prehospital intubation but not more likely to experience other adverse events. We included 2383 patients: 478 in the above and 1905 in the at/below dose group. Above-dose ketamine was associated with a higher rate of intubation or supraglottic airway placement (6.4% v 3.3%, OR 2.0, 95% CI 1.00–3.90). Other airway interventions were similar (40.0% v 40.0%, OR 1, 95% CI 0.80–1.30). The above-dose group also showed a higher rate of improvement noted by EMS clinicians (92.5% v 88.7%, OR 1.6, 95% CI 1.01–2.40). The rates of antipsychotic coadministration, hypoxia, hypotension, and cardiac arrest were similar between the cohorts.

39. Ramgopal S, Martin-Gill C. Deviation from National Dosing Recommendations for Children Having Out-of-hospital Emergencies. Pediatrics. 2023;152(2):e2023061223

The aim of this study was to describe pediatric dosing deviations from nationally recommended guidelines for commonly administered medications from a registry of prehospital encounters. We evaluated prehospital patient care records for children (<18 years) from approximately 2000 emergency medical services agencies from 2020 to 2021. We investigated dosing deviations (defined as being $20% of the weight-appropriate dose from national guidelines) for the following: lorazepam, diazepam, and midazolam for seizures; fentanyl, hydromorphone, morphine, and ketorolac; intramuscular epinephrine and diphenhydramine for children with allergy or anaphylaxis; intravenous epinephrine; and methylprednisolone. Of 990 497 pediatric encounters, 63 963 (6.4%) received at least 1 nonnebulized medication. Among nonnebulized doses, 53.9% were for the studied drugs. Among encounters who received a study drug and which had a documented weight (80.3%), the overall consistency with national guidelines was 42.6 per 100 administrations. Appropriate dosing was most common with methylprednisolone (75.1%), intramuscular epinephrine (67.9%), and ketorolac (56.4%). Medications with the lowest consistency with national guidelines were diazepam (19.5%) and lorazepam (21.2%). Most deviations represented an underdose, which was greatest with lorazepam (74.7%) and morphine (73.8%). Results were similar when estimating dosages from weights calculated by age.

40. Crowe RP, Kennel J, Fernandez AR, Burton BA, Wang HE, Van Vleet L, Bourn SS, Myers JB. Racial, Ethnic, and Socioeconomic Disparities in Out-of-Hospital Pain Management for Patients With Long Bone Fractures. Ann Emerg Med. 2023 May 12:S0196-0644(23)00267-6. doi: 10.1016/j.annemergmed.2023.03.035. Epub ahead of print. PMID: 37178100.

The study objective was to evaluate racial and ethnic disparities in out-of-hospital analgesic administration, accounting for the influence of clinical characteristics and community socioeconomic vulnerability, among a national cohort of patients with long bone fractures. Using the 2019-2020 ESO Data Collaborative, we retrospectively analyzed emergency medical services (EMS) records for 9-1-1 advanced life support transport of adult patients diagnosed with long bone fractures at the emergency department. We calculated adjusted odds ratios (aOR) and 95% confidence intervals (CI) for out-of-hospital analgesic administration by race and ethnicity, accounting for age, sex, insurance, fracture location, transport time, pain severity, and scene Social Vulnerability Index. We reviewed a random sample of EMS narratives without analgesic administration to identify whether other clinical factors or patient preferences could explain differences in analgesic administration by race and ethnicity. Among 35,711 patients transported by 400 EMS agencies, 81% were White, non-Hispanic, 10% were Black, non-Hispanic, and 7% were Hispanic. In crude analyses, Black, non-Hispanic patients with severe pain were less likely to receive analgesics compared with White, non-Hispanic

patients (59% versus 72%; Risk Difference: -12.5%, 95% CI: -15.8% to -9.9%). After adjustment, Black, non-Hispanic patients remained less likely to receive analgesics compared with White, non-Hispanic patients (aOR:0.65, 95% CI:0.53 to 0.79). Narrative review identified similar rates of patients declining analgesics offered by EMS and analgesic contraindications across racial and ethnic groups.

41. **Niederberger SM, Crowe RP, Salcido DD, Menegazzi JJ. Sodium bicarbonate administration is associated with improved survival in asystolic and PEA Out-of-Hospital cardiac arrest. Resuscitation. 2023 Jan;182:109641. doi: 10.1016/j.resuscitation.2022.11.007. Epub 2022 Nov 18. PMID: 36403821; PMCID: PMC9877137.**

The objective of this study was to analyze the association of bicarb with resuscitation outcomes in non-traumatic OHCA. Records were obtained from the 2019-2020 ESO Data Collaborative prehospital electronic health record database, spanning 1,322 agencies in 50 states. OHCAs with resuscitations lasting 5-40 minutes were stratified by presenting ECG rhythm (VF/VT, pulseless electrical activity (PEA), asystole) for analysis. The outcomes of any prehospital ROSC and survival to discharge were compared by bicarb status using propensity score matching and logistic regressions with/without adjustment. 23,567 records were analyzed; 6,663 (28.3 %) of which included bicarb administration. In the propensity-matched cohort, ROSC was higher in the bicarb group for the asystole group (bicarb 10.6 % vs control 8.8 %; p = 0.013), without differences in the PEA or VF/VT groups. Survival was higher in the bicarb group for asystole (bicarb 3.3 % vs control 2.4 %; p = 0.020) and for PEA (bicarb 8.1 % vs control 5.4 %; p = 0.034), without differences in the VF/VT group. These results were consistent across adjusted/unadjusted logistic regression analyses.

42. **Pack CE, Partain AT, Crowe RP, Brown LH. Ambulance Transport Destinations In The US Differ By Patient Race And Ethnicity. Health Aff (Millwood). 2023 Feb;42(2):237-245. doi: 10.1377/hlthaff.2022.00628. PMID: 36745829.**

The aim of this study was to explore whether ambulance transport destinations contribute to health care disparities. Using a national emergency medical services research data set for calendar year 2020, we made within-ZIP code comparisons of the transport destinations for White patients and non-White patients transported by ambulance from emergency scenes. We used the dissimilarity index to measure transport destination discordances and decided a priori that a more than 5 percent difference in transport destinations (that is, dissimilarity index >0.05) would be practically meaningful. We found meaningful differences in the destination hospitals for White and non-White patients transported by ambulance from locations in the same ZIP code. The median ZIP code dissimilarity index was 0.08, 64 percent of ZIP codes had a dissimilarity index above 0.05, and 61 percent of patients were transported from ZIP codes with a dissimilarity index above 0.05. Forty-one percent of ZIP codes had a dissimilarity index above 0.10, and one-third of the patients were transported from those ZIP codes.

43. **Sandoval S, Goyal A, Frawley J, Gappy R, Chen NW, Crowe RP, Swor R. Prehospital Use of Ketamine versus Benzodiazepines for Sedation among Pediatric Patients with Behavioral Emergencies. Prehosp Emerg Care. 2023 Jan 20:1-7. doi: 10.1080/10903127.2022.2163326. Epub ahead of print. PMID: 36629484.**

The objective of this study was to compare the effectiveness and safety of ketamine and benzodiazepines when used for emergent prehospital sedation of pediatric patients with behavioral emergencies. We performed a retrospective review of 9-1-1 EMS records from the 2019-2020 ESO Data Collaborative research datasets. We included patients ≤18 years of age who received ketamine or benzodiazepines for EMS primary and secondary impressions indicating behavioral conditions. We excluded patients with first Glasgow Coma Scale (GCS) scores ≤8, those receiving ketamine or benzodiazepines prior to EMS arrival, those receiving both ketamine and benzodiazepines, and interfacility transfers. Effectiveness outcomes included general clinician assessment of improvement, decrease in GCS, and administration of a subsequent sedative. Safety outcomes

included mortality; advanced airway placement; ventilatory assistance without advanced airway placement; or marked sedation (GCS ≤8). Chi-square and t-tests were used to compare the ketamine and benzodiazepines groups. Of 57,970 pediatric patients with behavioral complaints and GCS scores >8, 1,539 received ketamine (13.3%, n = 205) or a benzodiazepine (86.7%, n = 1,334). Most patients were ≥12 years old (89.2%, n = 1,372), predominantly Caucasian (48.3%, n = 744), and were equally distributed by sex (49.7% male, n = 765). First treatment with ketamine was associated with a greater likelihood of improvement (88.8% vs 70.5%, p < 0.001) and a greater average GCS reduction compared to treatment with benzodiazepines (-2.5 [SD:4.0] vs -0.3 [SD:1.7], p < 0.001). Fewer patients who received ketamine received subsequent medication compared to those who received benzodiazepines (12.2% vs 27.0%, p < 0.001). Marked sedation was more frequent with ketamine than benzodiazepines (28.8% vs 2.9%, p < 0.001). Provision of ventilatory support (1.5% vs 0.5%, p = 0.14) and advanced airway placement (1.0% vs 0.2%, p = 0.09) were similar between ketamine and benzodiazepine groups. No prehospital deaths were reported.

44. Smida T, Menegazzi J, Crowe R, Scheidler J, Salcido D, Bardes J. A Retrospective Nationwide Comparison of the iGel and King Laryngeal Tube Supraglottic Airways for Out-of-Hospital Cardiac Arrest Resuscitation. Prehosp Emerg Care. 2023 Feb 13:1-7. doi: 10.1080/10903127.2023.2169422. Epub ahead of print. PMID: 36652451.

The objective of this study was to compare outcomes of OHCA patients who had airway management by emergency medical services (EMS) with the iGel or King-LT. We used the 2018-2021 ESO Data Collaborative public use research datasets for this retrospective study. All patients with non-traumatic OHCA who had iGels or King-LTs inserted by EMS were included. Our primary outcome was survival to discharge to home, and secondary outcomes included first-pass success, return of spontaneous circulation (ROSC), and prehospital rearrest. We examined the association between airway device and each outcome using two-level mixed effects logistic regression with EMS agency as the random effect, adjusted for standard Utstein variables and failed intubation prior to supraglottic airway insertion. Average treatment effects were calculated through propensity score matching. A total of 286,192 OHCA patients were screened, resulting in 93,866 patients eligible for inclusion in this analysis. A total of 9,456 transported patients (59.8% iGel) had associated hospital disposition data. Use of the iGel was associated with greater survival to discharge to home (aOR:1.36 [1.06, 1.76]; ATE: 2.2%[+0.5, +3.8]; n = 7,576), first pass airway success (aOR:1.94 [1.79, 2.09]; n = 73,658), and ROSC (aOR:1.19 [1.13, 1.26]; n = 73,207) in comparison to airway management with the King-LT. iGel use was associated with lower odds of experiencing a rearrest (aOR:0.73 [0.67, 0.79]; n = 20,776).Among patients who received a supraglottic device as a primary airway, use of the iGel was not associated with significantly greater survival to discharge to home (aOR:1.26 [0.95, 1.68]). Among patients who received a supraglottic device as a rescue airway following failed intubation, use of the iGel was associated with greater odds of survival to discharge to home (aOR:2.16 [1.15, 4.04]).

45. Breyre A, Crowe RP, Fernandez AR, Jabr A, Myers JB, Kupas DF. Emergency medical services clinicians in the United States are increasingly exposed to death. J Am Coll Emerg Physicians Open. 2023 Feb 15;4(1):e12904. doi: 10.1002/emp2.12904. PMID: 36817079; PMCID: PMC9930738.

The aim of this study was to describe changes in EMS encounters involving on-scene death from 2018 to 2021. We retrospectively analyzed deidentified EMS records for 9-1-1 responses from the ESO Data Collaborative from 2018 to 2021. We identified cases where patient dispositions of death on scene, with or without attempted resuscitation, and without EMS transport. A non-parametric test of trend was used to assess for monotonic increase in agency-level encounters involving on-scene death and the proportion of EMS clinicians exposed to ≥1 on-scene death. We analyzed records from 1109 EMS agencies. These agencies responded to 4,286,976 calls in 2018, 5,097,920 calls in 2019, 4,939,651 calls in 2020, and 5,347,340 calls in 2021.The total number of encounters with death on scene rose from 49,802 in 2018 to 60,542 in 2019 to 76,535 in 2020 and 80,388 in

2021. Agency-level annual counts of encounters involving death on scene rose from a median of 14 (interquartile range [IQR], 4-40) in 2018 to 2023 (IQR, 6-63) in 2021 (P-trend < 0.001). In 2018, 56% of EMS clinicians responded to a call with death on scene, and this number rose to 63% of EMS clinicians in 2021 (P-trend < 0.001).

46. Ramgopal S, Sepanski RJ, Crowe RP, Martin-Gill C. Age-based centiles for diastolic blood pressure among children in the out-of-hospital emergency setting. J Am Coll Emerg Physicians Open. 2023 Feb 25;4(2):e12915. doi: 10.1002/emp2.12915. PMID: 36852188; PMCID: PMC9958513.

The objective of the study was to compare Pediatric Advanced Life Support (PALS) diastolic blood pressure (DBP) criteria to empirically derived DBP criteria for the prediction of out-of-hospital interventions in children. We performed a retrospective study of pediatric (<18 years) encounters from the ESO Data Collaborative, which includes approximately 2000 Emergency Medical Services agencies in the United States. We developed age-based centile curves for DBP using generalized additive models for location, scale, and shape. We compared the proportion of encounters with a low DBP when using empirically derived and PALS criteria and calculated their associations with the delivery of out-of-hospital interventions (advanced airway management, cardiopulmonary resuscitation, cardiac epinephrine, any systemic epinephrine, defibrillation, and bolus intravenous fluids). We included 343,129 encounters. When using PALS criteria, 155,564 (45.3%) were classified as having abnormal DBP, including 120,624 (35.2%) with high DBP and 34,940 (10.2%) with low DBP. When using empirically-derived criteria, 18.6% had an abnormal DBP (ie, a DBP <10th or >90th centile). The accuracy of low DBP for out-of-hospital interventions between the two criteria was similar.

47. Frawley J, Goyal A, Gappy R, Sandoval S, Chen NW, Crowe R, Swor R. A Comparison of Prehospital Pediatric Analgesic Use of Ketamine and Opioids. Prehosp Emerg Care. 2023 Mar 8:1-5. doi: 10.1080/10903127.2023.2183295. Epub ahead of print. PMID: 36857195.

The objective of the study was to compare pain reduction, adverse events, and prehospital deaths between ketamine and opioids when used for analgesia administered by any route among pediatric patients. This was a retrospective review of 9-1-1 EMS records of injured pediatric patients (≤17 years of age) who received ketamine or opioids for analgesia using the ESO Data Collaborative (calendar years 2019-2020). We excluded interfacility transfers, patients receiving both medications, those with EMS clinician impressions indicating behavioral disorders, and those who received medication to facilitate advanced airway placement. EMS narrative review was performed to confirm ketamine use was for analgesia and to identify any unplanned airway placements. We assessed pain score reduction (0-10 ordinal scale) and clinician-documented patient response (improved, unchanged, worsened, unknown). Adverse events were defined as change in vital signs (GCS, SBP, RR, SpO2), bag valve mask ventilation alone, or death. Descriptive statistics were calculated to compare outcomes between groups. Overall, 9,223 patients were included, 190 (2.1%) received ketamine and 9,033 (97.9%) received opioids. Mean age in years was 12.8 [SD 4.0] for ketamine and 12.7 [SD 4.0] for opioids. Patients in both groups experienced pain reduction, and more patients receiving ketamine had EMS clinician reported improvement (93.2% vs. 87.9%, p = 0.03). Ketamine was associated with a greater average reduction in pain score than opioids (mean difference: -4.4 [SD 3.5], and -3.1 [SD 2.8], p < 0.001). Adverse events were rare with few patients receiving ventilatory support following the use of ketamine or opioids, (0, [SD 0.0%] vs. 6 [SD 0.1%], p = 1). There were no unplanned airway placements or prehospital deaths identified.

48. Smida T, Price BS, Scheidler J, Crowe R, Wilson A, Bardes J. Stay and play or load and go? The association of on-scene advanced life support interventions with return of spontaneous circulation following traumatic cardiac arrest. Eur J Trauma Emerg Surg. 2023 May 10. doi: 10.1007/s00068-023-02279-9. Epub ahead of print. PMID: 37162554.

The aim of the study was to examine whether on-scene advanced life support (ALS) would increase the odds of arriving at the emergency department with ROSC (ROSC at ED) in comparison to performance of no ALS or ALS en route. We utilized the 2018-2021 ESO Research Collaborative public use datasets for this study, which contain patient care records from ~2000 EMS agencies across the US. All OHCA patients with an etiology of "trauma" or "exsanguination" were screened (n=15,691). The time of advanced airway management, vascular access, and chest decompression was determined for each patient. Logistic regression modeling was used to evaluate the association of ALS intervention timing with ROSC at ED. 4942 patients met inclusion criteria. 14.6% of patients had ROSC at ED. In comparison to no vascular access, on-scene (aOR: 2.14 [1.31, 3.49]) but not en route vascular access was associated with increased odds of having ROSC at ED arrival. In comparison to no chest decompression, neither en route nor on-scene chest decompression were associated with ROSC at ED arrival. Similarly, in comparison to no advanced airway management, neither en route nor on-scene advanced airway management were associated with ROSC at ED arrival. The odds of ROSC at ED decreased by 3% (aOR: 0.97 [0.94, 0.99]) for every 1-minute increase in time to vascular access and decreased by 5% (aOR: 0.95 [0.94, 0.99]) for every 1-minute increase in time to epinephrine.

49. Ramgopal S, Sepanski RJ, Crowe RP, Martin-Gill C. External Validation of Empirically Derived Vital Signs in Children and Comparison to Other Vital Signs Classification Criteria. Prehosp Emerg Care. 2023 May 19:1-9. doi: 10.1080/10903127.2023.2206473. Epub ahead of print. PMID: 37105575.

The aim of the study was to externally validate pediatric vital sign ranges empirically derived from the prehospital setting and to compare the proportion of children who received prehospital interventions using current common classification systems versus empirically derived vital sign ranges. We retrospectively reviewed pediatric (<18 years) prehospital records from the 2021 ESO Collaborative dataset. We compared the proportions of encounters having vital signs (heart rate, respiratory rate, and systolic blood pressure) at the cutoffs of >99th, >95th, >90th, <10th, <5th and <1st centiles to previously reported centiles derived from EMS encounters in 2019-2020. We compared the deviation of mean Z-score by age between data sources. We identified the proportion of encounters with extreme (defined as <10th or >90th centile) vital signs who received prehospital interventions for the empirically derived criteria to six other classification criteria. 510,414 encounters were included, of which 66.9% were for medical indications and 70.7% resulted in hospital transport. The study sample had similar proportions of encounters identified at studied cutoffs compared to the previously published derivation sample, with all differences in proportions ≤1.1% between samples. All mean Z-scores were within 0.2 standard deviations of those from the derivation sample for each vital sign. Using empirically derived criteria, 34.2% had at least one extreme vital sign, compared to 69.1% with Pediatric Advanced Life Support criteria. Empirically derived extreme vital signs identified a higher proportion of children requiring most prehospital interventions compared to other vital signs criteria.

50. Fernandez AR, Bourn SS, Hall GD, Crowe RP, Myers JB. Patient Outcomes Based on the 2011 CDC Guidelines for Field Triage of Injured Patients. J Trauma Nurs. 2023 Jan-Feb 01;30(1):5-13. doi: 10.1097/JTN.0000000000000691. PMID: 36633338.

The objective of the study was to evaluate the association of positive findings on Centers for Disease Control and Prevention Guidelines for Field Triage of Injured Patients with hospitalization and mortality. This retrospective study included all 911 responses from the 2019 ESO Data Collaborative research dataset with complete Centers for Disease Control and Prevention Guidelines for Field Triage of Injured Patients and linked emergency department dispositions, excluding children and cardiac arrests prior to EMS arrival. Patients were categorized by Centers for Disease Control and Prevention Guidelines for Field Triage of Injured Patients step(s) met. Outcomes were hospitalization and emergency department or inhospital mortality. There were 86,462 records included: n = 65,967 (76.3%) met no criteria, n = 16,443 (19.0%) met one step (n = 1,571 [9.6%] vitals, n = 1,030 [6.3%]

anatomy of injury, n = 993 [6.0%] mechanism of injury, and n = 12,849 [78.1%] special considerations), and n = 4,052 (4.7%) met multiple. Compared with meeting no criteria, hospitalization odds increased threefold for vitals (odds ratio [OR]: 3.07, 95% confidence interval [CI]: 2.77-3.40), fourfold for anatomy of injury (OR: 3.94, 95% CI: 3.48-4.46), twofold for mechanism of injury (OR: 2.00, 95% CI: 1.74-2.29), or special considerations (OR: 2.46, 95% CI: 2.36-2.56). Hospitalization odds increased ninefold when positive in multiple steps (OR: 8.97, 95% CI: 8.37-9.62). Overall, n = 84,473 (97.7%) had mortality data available, and n = 886 (1.0%) died. When compared with meeting no criteria, mortality odds increased 10-fold when positive in vitals (OR: 9.58, 95% CI: 7.30-12.56), twofold for anatomy of injury (OR: 2.34, 95% CI: 1.28-4.29), or special considerations (OR: 2.10, 95% CI: 1.71-2.60). There was no difference when only positive for mechanism of injury (OR: 0.22, 95% CI: 0.03-1.54). Mortality odds increased 23-fold when positive in multiple steps (OR: 22.7, 95% CI: 19.7-26.8).

51. Smida T, Menegazzi JJ, Crowe RP, Bardes J, Scheidler JF, Salcido DD. Association of prehospital post-resuscitation peripheral oxygen saturation with survival following out-of-hospital cardiac arrest. Resuscitation. 2022 Dec;181:28-36. doi: 10.1016/j.resuscitation.2022.10.011. Epub 2022 Oct 19. PMID: 36272616.

The objective of the study was to retrospectively examine the association of prehospital post-ROSC hypoxia and hyperoxia with the primary outcome of survival to discharge home. 2019-2021 ESO Data Collaborative public use research datasets were used for this study. Average prehospital SpO_2, lowest recorded prehospital SpO_2, and hypoxia dose were calculated for each patient. The association of these measures with survival was explored using multivariable logistic regression. Prehospital post-ROSC hypoxia and hyperoxia were associated with worse outcomes in this dataset. After application of exclusion criteria, 19,023 patients were included in this study. Of these, 52.3% experienced at least one episode of post-ROSC hypoxia (lowest SpO_2 < 90%) and 19.6% experienced hyperoxia (average SpO_2 > 98%). In comparison to normoxic patients, patients who were hypoxic on average (AHA aOR: 0.31 [0.25, 0.38]; ERC aOR: 0.34 [0.28, 0.42]) and patients who had a hypoxic lowest recorded SpO_2 (AHA aOR: 0.48 [0.39, 0.59]; ERC aOR: 0.52 [0.42, 0.64]) had lower adjusted odds of survival. Patients who had a hyperoxic average SpO_2 (AHA aOR: 0.75 [0.59, 0.96]; ERC aOR: 0.68 [0.53, 0.88]) and patients who had a hyperoxic lowest recorded SpO_2 (AHA aOR: 0.66 [0.48, 0.92]; ERC aOR: 0.65 [0.46, 0.92]) also had lower adjusted odds of survival.

52. Joiner A, Fernandez AR, Van Vleet L, Cabañas JG, Grover J, Godfrey A, Crowe R, Staton C, Pavon J. Predictors of Non-Transport for Older Adult EMS Patients Encountered for Falls. Prehosp Emerg Care. 2022 Oct 28:1-7. doi: 10.1080/10903127.2022.2137744. Epub ahead of print. PMID: 36251394.

The objective of this study was to describe characteristics associated with non-transport among older adult EMS patients encountered for falls. A national retrospective cross-sectional study of 9-1-1 patient contacts was conducted using data from the 2019 ESO Data Collaborative. Potential predictors of non-transport included patient demographics, initial vital signs, who requested 9-1-1 service, incident location, alcohol/substance use, and urbanicity. Multivariable logistic regression was used to determine associations between non-transport and potential predictors. Males, older age groups, and Hispanic/Latino patients had higher odds of non-transport among this population of community-dwelling adults aged 60 or greater. 195,204 EMS encounters for older adults who fell in 2019 were identified, including 27,563 (14.1%) non-transports. Most patients were female (62.4%), non-Hispanic White (85.4%), and fell at a home or residence (80.4%). Greater odds of non-transport were identified among males (OR 1.37, 95% CI 1.32-1.42) and Hispanic/Latino patients (OR 1.24, 95% CI 1.14-1.35). Older age was associated with greater odds of non-transport compared to patients aged 60-69 years (70-79 [OR 1.42, 95% CI 1.35-1.49], 80-89 [OR 1.51, 95% CI 1.42-1.59], ≥90 [OR 1.45, 95% CI 1.35-1.55]). Patients residing in Census tracts with larger percentages of the population living in poverty had lower odds of non-transport compared to those in areas with ≤5% in

poverty (6-15% poverty [OR 0.82, 95% CI 0.78-0.84), 15-25% poverty [OR 0.78, 95% CI 0.73-0.82], and >25% poverty [OR 0.78, 95% CI 0.72-0.84]).

53. Smida T, Menegazzi JJ, Crowe RP, Weiss LS, Salcido DD. Association of prehospital hypotension depth and dose with survival following out-of-hospital cardiac arrest. Resuscitation. 2022 Sep 30;180:99-107. doi: 10.1016/j.resuscitation.2022.09.018. Epub ahead of print. PMID: 36191809.

The study objective was to examine the association between duration and depth of prehospital post return of spontaneous circulation (ROSC) hypotension and survival. Data from the 2019 and 2020 ESO Data Collaborative research data set were analyzed. Hypotension dose (mmHg*min.), average prehospital systolic blood pressure (SBP), and lowest recorded prehospital SBP were calculated. The association of these measures with survival to home (STH) and rearrest were explored using multivariable logistic regression. Time to hypotension resolution analyses by hypotension management strategy (push dose vasopressors, vasopressor infusion, or fluid only) were conducted using adjusted Cox proportional hazards models. Severity and duration of hypotension were significantly associated with worse outcomes in this dataset. 17,280 OHCA patients met inclusion criteria, of which 3,345 had associated hospital outcome data. Over one-third (37.8%; 6,526/17,280) of all patients had at least one recorded SBP below 90 mmHg. When modeled continuously, average prehospital SBP (1.19 [1.15, 1.23] per 10 mmHg), lowest prehospital SBP (1.20 [1.17, 1.24] per 10 mmHg), and hypotension dose (0.995 [0.993, 0.996] per mmHg*min.) were independently associated with STH. Differences in hypotension management were not associated with differences in survival or time to hypotension resolution.

54. Guterman EL, Sporer KA, Newman TB, Crowe RP, Lowenstein DH, Josephson SA, Betjemann JP, Burke JF. Real-World Midazolam Use and Outcomes With Out-of-Hospital Treatment of Status Epilepticus in the United States. Ann Emerg Med. 2022 Oct;80(4):319-328. doi: 10.1016/j.annemergmed.2022.05.024. Epub 2022 Aug 2. PMID: 35931608.

The aim of this study was to examine the effectiveness of midazolam in a national out-of-hospital cohort. 2019 data form the ESO Data Collaborative research dataset was used to conduct a retrospective cohort study of adults with status epilepticus. There were 7,634 out-of-hospital encounters from 657 EMS agencies. Midazolam was administered intranasally in 20%, intravenously in 46%, and intramuscularly in 35% of the encounters. Compared with intramuscular administration, intranasal midazolam increased (risk difference [RD], 6.5%; 95% confidence interval [CI], 2.4% to 10.5%) and intravenous midazolam decreased (RD, -11.1%; 95% CI, -14.7% to -7.5%) the risk of rescue therapy. The differences in ventilatory support were not statistically significant (intranasal RD, -1.5%; 95% CI, -3.2% to 0.3%; intravenous RD, -0.3%; 95% CI, -1.9% to 1.2%). Higher doses were associated with a lower risk of rescue therapy (RD, -2.6%; 95% CI, -3.3% to -1.9%) and increased ventilatory support (RD, 0.4%; 95% CI, 0.1% to 0.7%). The instrumental variable analysis yielded similar results, except that dose was not associated with ventilatory support. Compared with intramuscular administration, intranasal administration may be less effective and intravenous administration more effective in terminating status epilepticus, although the differences between these and previous results may reflect the nature of real-world data as opposed to randomized data.

55. Aceves A, Crowe RP, Zaidi HQ, Gill J, Johnson R, Vithalani V, Fairbrother H, Huebinger R. Disparities in Prehospital Non-Traumatic Pain Management. Prehosp Emerg Care. 2022 Sep 6:1-6. doi: 10.1080/10903127.2022.2107122. Epub ahead of print. PMID: 35939557.

The study objective was to evaluate EMS encounters for racial and ethnic disparities in analgesia given for non-traumatic pain. 2018 and 2019 data from the ESO Data Collaborative was used in this analysis. All transported, adult, non-traumatic encounters with a primary or secondary impression of a pain complaint were included and stratified based on race and ethnicity as recorded by the EMS clinicians. A mixed model analysis was performed, modeling EMS agency as a random intercept and adjusting for age, sex, pain location, level of service, location of incident, and highest pain score. The

association between race/ethnicity and receiving any pain medication (acetaminophen, non-steroidal anti-inflammatories, or opioids), receiving opioid pain medication, and receiving pain medication within 20 minutes of EMS arrival was evaluated using non-Hispanic White patients as the reference group. 1,035,486 patients were included in this analysis; 67.5% non-Hispanic White, 26.8% Black, 4.9% Hispanic, 0.5% Asian, 0.1% Native Hawaiian or Other Pacific Islander, and 0.2% American Indian or Alaska Native patients. 4.7% of patients received pain medications. Compared to White patients (5.1%), Black patients were less likely to receive pain medication (3.3%, aOR 0.7; 95% CI 0.7-0.7) and Hispanics were more likely to receive pain medication (7.6%, aOR 1.5; 95% CI 1.4-1.6). Black patients were also less likely to receive opioids (1.8% for Black v 3.0% for White, aOR 0.7; 95% CI 0.6-0.7), while Hispanic patients were more likely to receive opioids (4.9%, aOR 1.4; 95% CI 1.3-1.5). The odds of receiving pain medication within 20 minutes was lower for Black patients (aOR 0.9; 95% CI 0.8-0.95) but no different for Hispanic patients (aOR 1.0; 95% CI 0.9-1.1), when compared to White patients.

56. Goyal A, Frawley J, Gappy R, Sandoval S, Chen NW, Crowe RP, Swor R. Prehospital Ketamine Use in Pediatrics. Prehosp Emerg Care. 2022 Jul 19:1-6. doi: 10.1080/10903127.2022.2096161. Epub ahead of print. PMID: 35771721.

The study objective was to describe patient characteristics among pediatric EMS patients who received ketamine. Records from the 2019 and 2020 ESO Data Collaborative for all 911 transports of pediatric patients (≤18 years of age) who received ketamine were used for this analysis. EMS primary impressions were used as a proxy for medication indication. Most patients were observed to improve after ketamine use and most injured patients reported decreases in pain scores. Few significant adverse events related to ketamine use in this population were observed. Out of 422,968 ground-ambulance pediatric patients, 1,291 received ketamine. They were predominately male (842, 65.2%), teenagers (median age 16, IQR: 13-17), Caucasian (810, 62.7%), and from urban areas (1,041, 80.6%). The most common EMS impressions were related to injuries (810, 62.7%) and behavior disorders (281, 21.8%). Only 980/1,291 (75.9%) had weights and identifiable routes recorded. Most patients (960, 74.4%) received single doses of ketamine, with EMS clinicians reporting improvement in 855 (89.1%) of 960 patients. Among non-behavioral emergency patients, 727/1,010 (72.0%) had pain scores recorded. Pain scores decreased significantly from a median of 8 (IQR: 4-10) to 2 (IQR: 0-6) ($p < 0.001$) with 59% (429) of 727 patients reporting pain score reductions of 2 or more points. Desaturation (<90% SpO2) events were noted to be minimal (1.8%). A small number (28, 2.2%) received positive pressure ventilation without advanced airway placement. No prehospital deaths were documented.

57. Harris M, Crowe RP, Anders J, D'Acunto S, Adelgais KM, Fishe JN. Identification of Factors Associated with Return of Spontaneous Circulation after Pediatric Out-of-Hospital Cardiac Arrest Using Natural Language Processing. Prehosp Emerg Care. 2022 May 23:1-8. doi: 10.1080/10903127.2022.2074180. Epub ahead of print. PMID: 35510881.

The study objective was to use Natural Language Processing (NLP) to examine EMS clinician free-text narratives for characteristics associated with prehospital return of spontaneous circulation (ROSC) in pediatric out-of-hospital cardiac arrest (OHCA). Records from the 2019 ESO Data Collaborative of patients ages 0–17 with OHCA were used in this analysis. An exploratory analysis of EMS narratives was performed using NLP with an *a priori* token library; biostatistical and machine learning models compared performance in predicting ROSC. Free-text narratives revealed additional characteristics associated with prehospital ROSC in pediatric OHCA and incorporation of those terms into machine learning models of prehospital ROSC improved predictive ability. There were 1,726 EMS encounters for pediatric OHCA included for analysis; 60% were male patients, and the median age was 1 year (IQR 0–9). Most cardiac arrest events (61.3%) were unwitnessed, 87.3% were identified as having medical causes, and 5.9% had initial shockable rhythms. Prehospital ROSC was achieved in 23.1%. Words most positively correlated with ROSC were “ROSC” ($r = 0.42$), “pulse” ($r = 0.29$), “drowning” (r

= 0.13), and “PEA” (r =0.12). Words negatively correlated with ROSC included “asystole” (r =-0.25), “lividity” (r =0.14), and “cold” (r =-0.14). The terms “asystole,” “pulse,” “no breathing,” “PEA,” and “dry” had the greatest difference in frequency of appearance between encounters with and without ROSC ($p < 0.05$). The best-performing model for predicting prehospital ROSC was logistic regression with random oversampling using free-text data only (area under the receiver operating characteristic curve 0.92).

58. Lowery B, D'Acunto S, Crowe RP, Fishe JN. Using Natural Language Processing to Examine Social Determinants of Health in Prehospital Pediatric Encounters and Associations with EMS Transport Decisions. Prehosp Emerg Care. 2022 May 23:1-6. doi: 10.1080/10903127.2022.2072984. Epub ahead of print. PMID: 35500212.

The study objective was to examine the presence of social determinants of health (SDOH) in EMS clinician free text notes and quantify the association of SDOH with EMS pediatric transport decisions. The 2019 ESO Data Collaborative research dataset was used in this analysis using records from patients ages 0-17; cases of cardiac arrests and patients in law enforcement custody were excluded from the analysis. Natural language processing (NLP) was used to extract the following SDOH categories: income insecurity, food insecurity, housing insecurity, insurance insecurity, poor social support, and child protective services. SDOH documentation in the EMS narrative was rare among pediatric encounters; however, children with documented SDOH were more likely to be transported. 325,847 pediatric EMS encounters were analyzed, of which 35% resulted in non-transport. The median age was 10 years and 52% were male. Slightly over half (53%) were White, 31% were Black, and 11% were Hispanic. Child protective services (n = 2,620) and housing insecurity (n = 1,136) were the most common SDOH categories found in the EMS free text narratives. In the multivariable model, child protective services involvement (odds ratio (OR=2.04 [95% confidence interval (CI) 1.84–2.05]), housing insecurity (OR= 1.46 [95% CI 1.26–1.70]), insurance security (OR= 2.44 [95% CI 1.93–3.09]), and poor social support (OR= 10.48 [95% CI 1.42–77.29]) were associated with greater odds of EMS transport.

59. Brown, LH., Crowe, RP., Pepe, PE., Miller, ML., Watanabe, BL., Kordik, SS., Wampler, DA., Page, DI., Fernandez, AR., Bourn, SS., & Myers, JB. (2022, May). Adverse events following emergent prehospital sedation of patients with behavioral emergencies: A retrospective cohort study. The Lancet Regional Health - Americas, 9, 100183. https://doi.org/10.1016/j.lana.2021.100183. Epub 2022 Jan 15.

The study objective was to describe the frequency of adverse events (AEs) following emergent prehospital sedation with three types of sedative agents: ketamine, benzodiazepines, and antipsychotics. 2019 data from the ESO Data Collaborative was used in this analysis. The study looked at patients ≥ 15 years who presented with behavioral emergencies necessitating emergent prehospital sedation. Serious AEs (SAE) included cardiac arrest, invasive airway placement, and severe oxygen desaturation (<75%). Less-serious AEs included positive pressure ventilation, any oxygen desaturation (<90%), oropharyngeal or nasopharyngeal airway placement, and suctioning. The need for additional sedation was also assessed. Although SAEs were rare among patients receiving emergent prehospital sedation, prehospital clinicians should remain mindful of the potential risks and monitor patients closely. Of 7973 patients, 1996 received ketamine; 4137 received benzodiazepines; 1532 received an antipsychotic agent; and 308 received an indeterminant agent. Cardiac arrest occurred in 11 patients (0·1%) and any SAE occurred in 165 patients (2·1%). Invasive airway placement was more frequent with ketamine (40, 2·0%) compared with benzodiazepines (17, 0·4%) or antipsychotics (3, 0·2%). Oxygen desaturation below 75% also occurred more frequently with ketamine (51, 2·6%) than with benzodiazepines (52, 1·3%) or antipsychotics (14, 0·9%). Patients sedated with ketamine were less likely to require additional sedation.

60. Ashburn, NP., Snavely, AC., Angi, RM., Scheidler, JF., Crowe, RP., McGinnis, HD., Hiestand, BC., Miller, CD., Mahler, SA., Stopyra, JP. Prehospital time for patients with acute cardiac complaints: A rural health disparity. Am J Emerg Med. 2022 Feb;52:64-68. doi: 10.1016/j.ajem.2021.11.038. Epub 2021 Nov 30. PMID: 34871845.

The study objective was to quantify rural and urban differences in prehospital time intervals for patients with cardiac complaints. The ESO Data Collaborative dataset consisting of records from 1332 EMS agencies was queried for 9-1-1 encounters with acute cardiac problems among adults (age ≥ 18) from 1/1/2013-6/1/2018. Location was classified as rural or urban using the 2010 United States Census. The primary outcome was total prehospital time. Generalized estimating equations evaluated differences in the average times between rural and urban encounters while controlling for age, sex, race, transport mode, loaded mileage, and patient stability. Rural patients with acute cardiac complaints experienced longer prehospital time than urban patients, even after accounting for other key variables, such as loaded mileage. Among 428,054 encounters, the median age was 62 (IQR 50-75) years with 50.7% female, 75.3% white, and 10.3% rural. The median total prehospital, response, scene, and transport times were 37.0 (IQR 29.0-48.0), 6.0 (IQR 4.0-9.0), 16.0 (IQR 12.0-21.0), and 13.0 (IQR 8.0-21.0) minutes. Rural patients had an average total prehospital time that was 16.76 min (95%CI 15.15-18.38) longer than urban patients. After adjusting for covariates, average total time was 5.08 (95%CI 4.37-5.78) minutes longer for rural patients. Average response and transport time were 4.36 (95%CI 3.83-4.89) and 0.62 (95%CI 0.33-0.90) minutes longer for rural patients. Scene time was similar in rural and urban patients (0.09 min, 95%CI -0.15-0.33).

61. Hanna, A., Crowe, RP., Fishe, JN. Pediatric Bradycardia Is Undertreated in the Prehospital Setting: A Retrospective Multi-Agency Analysis. Prehosp Emerg Care. 2022 Jan 25:1-6. doi: 10.1080/10903127.2021.2018075. Epub ahead of print. PMID: 34913820.

The study objective was to investigate the incidence and management of pediatric bradycardia in the prehospital setting by emergency medical services. The 2019 ESO Data Collaborative research dataset was used for this analysis. All 911 scene response prehospital encounters for patients ages 0-18 were included Age-based bradycardia was identified per the 2015 AHA PALS guidelines. The analysis included general descriptive statistics and a univariate analysis examining any PALS-recommended interventions in the presence of altered mental status, hypotension for age, and a first heart rate less than 60. Incidence of prehospital pediatric bradycardia was rare, but adherence to PALS guidelines was variable. Of the 7,422,710 encounters in the 2019 ESO Data Collaborative, 1,209 patients met inclusion criteria. Most (58.5%) were male, and the median age was 2 years (interquartile range 0-13 years). One-quarter (24.7%) of patients received fluids, and bag-valve mask ventilation was the most common airway intervention (12.1% of patients). Receipt of any PALS-recommended interventions was associated with age-adjusted hypotension (odds ratio (OR) 4.0, 95% confidence interval (CI) 3.9-5.4) and altered mental status (OR 15.5, 95% CI 10.7-22.3), but not a first heart rate less than 60 bpm (OR 0.9, 95% CI 0.6-1.1).

62. Harris, MI., Crowe, RP., Anders, J., D'Acunto, S., Adelgais, KM., Fishe, J. Applying a set of termination of resuscitation criteria to paediatric out-of-hospital cardiac arrest. Resuscitation. (2021) Dec;169:175-181. doi: 10.1016/j.resuscitation. 2021.09.015. Epub 2021 Sep 20. PMID: 34555488.

The study objective was to apply a set of criteria for pediatric prehospital termination of resuscitation (pTOR) from the Maryland Institute for Emergency Medical Services Systems (MIEMSS) to a large national cohort and determine its association with return of spontaneous circulation (ROSC) after POHCA. The 2019 ESO Data Collaborative research dataset was used for this analysis. Patients ages 0-17 treated by EMS with cardiac arrest were included and the applicable pTOR criteria for medical or traumatic arrests was applied. There were 1595 POHCA patients. Eighty-eight percent (n = 1395) were classified as medical. ROSC rates were 23% among medical POHCA and 27% among traumatic POHCA. The medical criteria correctly classified >99% (322/323) of patients who achieved ROSC as

ineligible for TOR. The trauma criteria correctly classified 93% (50/54) of patients with ROSC as ineligible for TOR. Of the five misclassified patients, three were involved in drowning incidents. The Maryland pTOR criteria identified eligible patients who did not achieve prehospital ROSC, while reliably excluding those who did achieve prehospital ROSC. As most misclassified patients were victims of drowning, we recommend considering the exclusion of drowning patients from future pTOR guidelines. Further studies are needed to evaluate the long-term survival and neurologic outcome of patients misclassified by pTOR criteria.

63. Popp, LM., Lowell, LM., Ashburn, NP., Stopyra, JP. Adverse events after prehospital nitroglycerin administration in a nationwide registry analysis. Am J Emerg Med. (2021) Dec;50:196-201. doi: 10.1016/j.ajem.2021.08.006. Epub 2021 Aug 8. PMID: 34390902.

The study objective was to determine demographic and clinical factors associated with adverse events after prehospital NTG administration. The 2019 ESO Data Collaborative research dataset was used for this analysis. All 911 encounters where NTG was administered to patients ≥18 years old by EMS were included. Adverse event outcomes were defined as a new systolic blood pressure (SBP) < 90, heart rate (HR) < 50 or > 120, mean arterial pressure (MAP) < 65, or change in mental status following NTG administration. Descriptive statistics and logistic regression models adjusting for age, sex, race, ethnicity, intravenous (IV) access, and initial vital signs were used to assess for adverse event-related factors. Among 80,760 encounters, the mean age was 61 (IQR 50-72), with 52% males, 71% white race, and 7% Hispanic ethnicity. Adverse events occurred in 7% of encounters. Adverse events were found to be less common among Black patients (OR = 0.74, 95%CI:0.69-0.80). IV access obtained prior to NTG administration was associated with fewer adverse events (OR = 0.92, 95%CI:0.85-0.99). Increasing age (OR = 1.02, 95%CI:1.01-1.02) and HR (OR = 1.03, 95%CI:1.02-1.03) were associated with increased odds of adverse events while SBP (OR = 0.99, 95%CI:0.98-0.99) was inversely associated. Adverse events following prehospital NTG administration were rare, especially in patients with an SBP > 110 and a HR < 100, and less frequent in those with existing IV access. Demographics were not found to be clinically significant.

64. Walter, DC., Chan, KC., Crowe, RP., Osborn, L., Jarvis, J., Wang, HE. Out-of-hospital, non-invasive, positive-pressure ventilation for acute dyspnea. J Am Coll Emerg Physicians Open. (2021) Nov 4;2(6):e12542. doi: 10.1002/emp2.12542. PMID: 34761248; PMCID: PMC8567746.

The study objective was to determine the course and outcomes of out-of-hospital acute dyspnea patients treated with non-invasive, positive-pressure ventilation (NIPPV), including continuous positive airway pressure (CPAP) or bi-level positive air pressure (BPAP). This retrospect analysis utilized the 2018 ESO Data Collaborative research database. Acute dyspnea was defined as adults with an initial respiratory rate ≥ 30 breaths/min (bpm), with a primary or secondary EMS subjective impression of a respiratory condition, who received oxygen and/or a respiratory medication and had 2 or more recordings of respiratory rate (RR). Patients with trauma and those with altered mental status were excluded. The primary outcome was change in respiratory rate (RR), censored at 90 minutes of treatment. There were 33,585 EMS encounters for patients with acute dyspnea, including 8,750 (26.1%) NIPPV and 24,835 (73.9%) non-NIPPV encounters. Median treatment duration was similar between NIPPV and non-NIPPV (23.3 minutes vs 23.6 minutes, rank-sum $P = 0.266$). Common concurrent treatments included albuterol (NIPPV, 48.8%; non-NIPPV, 46.2%), ipratropium bromide (27.9%, 24.8%), and methylprednisolone (24.9%, 18.5%). At 20 minutes, mean RR change was slightly lower for the NIPPV group than non-NIPPV; -6.0 versus -6.8 breaths/min. At 40 minutes, mean RR change was similar between NIPPV and non-NIPPV groups; -7.7 versus -7.9 breaths/min. On linear mixed modeling adjusted for age, sex, incident location, race, ethnicity, agency type, initial RR, and medication use, NIPPV was associated with a smaller RR decrease across time than NIPPV; [NIPPV × time] interaction $P < 0.001$. Out-of-hospital advanced airway placement (endotracheal intubation or supraglottic airway insertion) was higher for NIPPV than non-NIPPV group (2.3% vs 1.3%, odds ratio = 2.23, 95% confidence interval = 2.01-2.47).

65. **Clemency, BM., Murk, W., Moore, A., Brown, LH. The EMS Modified Early Warning Score (EMEWS): A Simple Count of Vital Signs as a Predictor of Out-of-Hospital Cardiac Arrests. Prehosp Emerg Care. (2021) Apr 13:1-22. doi: 10.1080/10903127.2021.1908464. Epub ahead of print. PMID: 33794729.**

The study objective was to compare to the ability of Modified Early Warning Score (MEWS) and "EMS Modified Early Warning Score" (EMEWS) to identify patients at risk for EMS-witnessed out-of-hospital cardiac arrest (OHCA). This retrospect analysis utilized the 2018 ESO Data Collaborative research database. Patients without cardiac arrest before EMS arrival were categorized into those who did or did not have an EMS-witnessed arrest. MEWS was evaluated without its temperature component (MEWS-T). The performance of MEWS-T and EMEWS in predicting EMS witnessed arrest was evaluated by comparing receiver-operating characteristic curves. Of 369,064 included encounters, 4,651 were EMS witnessed arrests. MEWS-T demonstrated an area under the curve (AUC) of 0.79 (95% CI: 0.79 - 0.80), with 86.8% sensitivity and 51.0% specificity for MEWS-T ≥ 3. EMEWS demonstrated an AUC of 0.74 (95% CI: 0.73 - 0.75), with 81.3% sensitivity and 53.9% specificity for EMEWS ≥ 2. EMEWS showed a similar ability to predict EMS-witnessed cardiac arrest compared to MEWS-T, despite being significantly simpler to compute. Further study is needed to evaluate whether the implementation of EMEWS can aid EMS clinicians in anticipating and preventing OHCA.

66. **Bourn, S.S., Crowe, R.P., Fernandez, A.R., Matt, S.E., Brown, A.L., Hawthorn, A.B., Myers, J.B. (2021): Initial prehospital Rapid Emergency Medicine Score (REMS) to predict outcomes for COVID-19 patients. JACEP Open. https://doi.org/10.1002/emp2.12483**

The study objective was to determine whether the first prehospital REMS could predict emergency department and hospital dispositions for COVID-19 patients transported by emergency medical services. This study used linked prehospital and hospital records from the ESO Data Collaborative for all 911-initiated transports of patients with hospital COVID-19 diagnoses from July 1 to December 31, 2020. REMS was calculated with the first recorded prehospital values for each component. Area under the receiver operating curve (AUROC) was calculated for emergency department (ED) mortality, ED discharge, hospital mortality, and hospital length of stay (LOS). Optimal REMS cut-points were determined using test characteristic curves. Among 13,830 included COVID-19 patients, median REMS was 6 (interquartile range [IQR]: 5-9). ED mortality was <1% (n = 80). REMS ≥9 predicted ED death (AUROC 0.79). One-quarter of patients (n = 3,419) were discharged from the ED with an optimal REMS cut-point of ≤5 (AUROC 0.72). Eighteen percent (n = 1,742) of admitted patients died. REMS ≥8 optimally predicted hospital mortality (AUROC 0.72). Median hospital LOS was 8.3 days (IQR: 4.1-14.8 days). REMS ≥7 predicted hospitalizations ≥3 days (AUROC 0.62). Initial prehospital REMS was modestly predictive of ED and hospital dispositions for patients with COVID-19. Prediction was stronger for outcomes more proximate to the first set of emergency medical services (EMS) vital signs.

67. **Fernandez, AR., Bourn, SS., Crowe, RP., Bronsky, ES., Scheppke, KA., Antevy, P., Myers, JB. Out-of-Hospital Ketamine: Indications for Use, Patient Outcomes, and Associated Mortality. Ann Emerg Med. (2021) Jul;78(1):123-131. doi: 10.1016/j.annemergmed.2021.02.020. Epub 2021 Jun 7. PMID: 34112540.**

The study objective was to describe prehospital ketamine use, patient outcomes, and the potential contribution of ketamine to patient death. Using the ESO Data Collaborative, all 911 responses with prehospital ketamine administration from 1/1/2019 to 12/31/2019, excluding cardiac arrest prior to EMS arrival were queried. Measures included indications for ketamine administration, dosing, route, transport disposition, hypoxia, hypercapnia, and mortality. In cases involving patient death, physician review and consensus was used to determine whether ketamine could be excluded as a potential contributing factor. Descriptive statistics were calculated. There were 15,204 prehospital ketamine administrations among 11,291 patients. Indications included trauma/pain (49%, 5,575), altered mental status/behavioral (34%, 3,795), cardiovascular/pulmonary (13%, 1,454), seizure (2%, 248), and other (2%, 219). Median dose was highest for altered mental status/behavioral

indications at 3.7 mg/kg (interquartile range: 2.2-4.4 mg/kg). Over 99% (11,274) were transported to a hospital. Following ketamine administration, hypoxia and hypercapnia were documented in 8.4% (897) and 17.2% (1,311) of patients, respectively. Eight on-scene and 120 in-hospital deaths were reviewed. Ketamine could not be excluded as a contributing factor in 2 on-scene deaths representing 0.02% (95% CI: 0.00-0.07%) of all exposures. Among in-hospital deaths, ketamine could not be excluded as a contributing factor in 6 cases (0.3%, 95% CI: 0.1-0.7%).

68. Huebinger RM, Stilgenbauer H, Jarvis JL, Ostermayer DG, Schulz K, Wang HE. Video laryngoscopy for out of hospital cardiac arrest. Resuscitation. 2021 May;162:143-148. doi: 10.1016/j.resuscitation.2021.02.031. Epub 2021 Feb 25. PMID: 33640431.

The study objective was to evaluate the association of video laryngoscopy (VL) with first pass success and return of spontaneous circulation (ROSC) using a national out-of-hospital cardiac arrest (OHCA) cohort. This study used the 2018 ESO Data Collaborative to evaluate all adult, non-traumatic cardiac arrests undergoing endotracheal intubation. VL and direct laryngoscopy (DL) were defined based on paramedic recorded intubation device. The primary outcomes were first pass success, return of spontaneous circulation (ROSC), and sustained ROSC. Multivariable, mixed models, were used to determine the association between VL and first pass success rate, ROSC, and sustained ROSC (survival to ED or ROSC in the field for greater than 20 min), fitting agency as a random intercept and adjusting for confounders. There were 22,132 patients cared for by 914 EMS agencies, including 5702 (25.7%) VL and 16,430 (74.2%) DL. Compared to DL, VL had a lower rate of bystander CPR, but other characteristics were similar between the groups. VL exhibited higher first pass success than DL (75.1% v 69.5%, p < .001). On mixed model analysis, VL was associated with a higher first pass success (OR 1.5, CI 1.3-1.6) but not ROSC (OR 1.1, CI 0.97-1.2) or sustained ROSC (OR 1.1, CI 0.9-1.2). While associated with higher FPS, VL was not associated with increased rate of ROSC.

69. Clemency B.M., Murk W., Moore A., Brown L.H., (2021): The EMS Modified Early Warning Score (EMEWS): A Simple Count of Vital Signs as a Predictor of Out-of-Hospital Cardiac Arrests. Prehosp Emerg Care. 2021 Apr 13:1-22. doi: 10.1080/10903127.2021.1908464. Epub ahead of print. PMID: 33794729.

The study objective was to compare to the ability of the Modified Early Warning Score (MEWS) and the "EMS Modified Early Warning Score" (EMEWS) to identify patients at risk for EMS-witnessed out-of-hospital cardiac arrest. This study used the 2018 ESO Data Collaborative. Patients without cardiac arrest before EMS arrival were categorized into those who did or did not have an EMS-witnessed arrest. MEWS was evaluated without its temperature component (MEWS-T). The performance of MEWS-T and EMEWS in predicting EMS witnessed arrest was evaluated by comparing receiver-operating characteristic curves. Of 369,064 included encounters, 4,651 were EMS witnessed arrests. MEWS-T demonstrated an area under the curve (AUC) of 0.79 (95% CI: 0.79 - 0.80), with 86.8% sensitivity and 51.0% specificity for MEWS-T ≥ 3. EMEWS demonstrated an AUC of 0.74 (95% CI: 0.73 - 0.75), with 81.3% sensitivity and 53.9% specificity for EMEWS ≥ 2. EMEWS showed a similar ability to predict EMS-witnessed cardiac arrest compared to MEWS-T, despite being significantly simpler to compute.

70. Crowe, R.P., Bourn, S.S., Fernandez, A.R., Myers, J.B. (2021): Initial Prehospital Rapid Emergency Medicine Score (REMS) as a Predictor of Patient Outcomes, Prehospital Emergency Care, DOI: 10.1080/10903127.2020.1862944

The study objective was to assess predictive characteristics of initial prehospital Rapid Emergency Medicine Score (REMS) for ED disposition and overall patient mortality. This study used linked prehospital and Health Data Exchange records from the national ESO Data Collaborative. All 911 responses from January 1, 2019 to December 31, 2019 were included. REMS (0–26) was calculated using age and first prehospital values for: pulse rate, mean arterial pressure, respiratory rate, oxygen saturation, and Glasgow Coma Scale. Non-transports, patients <18 and cardiac arrests prior to EMS arrival were excluded. The primary outcome was ED disposition, dichotomized to

discharge versus admission, transfer, or death. The secondary outcome was overall survival to discharge (ED or inpatient). Predictive ability was assessed using area under the receiver operating curve (AUROC). Optimal REMS cut points were determined using test characteristic curves. Univariable logistic regression modeling was used to quantify the association between initial prehospital REMS and each outcome. A REMS of 5 or lower demonstrated optimal statistical prediction for ED discharge versus not discharged (admission/transfer/death) (AUROC: 0.68). Patients with initial prehospital REMS of 5 or lower showed a three-fold increase in odds of ED discharge (OR: 3.28, 95%CI: 3.24–3.32). A score 7 or lower was statistically optimal for predicting survival. Initial prehospital REMS of 7 or lower was associated with a five-fold increase in odds of overall survival (OR:5.41, 95%CI:5.15–5.69).

71. **Fernandez, A.R., Crowe, R.P., Bourn, S., Matt, S.E. Brown, A.L., Hawthorn, A.B., Myers, B. COVID-19 Preliminary Case Series: Characteristics of EMS Encounters with Linked Hospital Diagnoses. Prehosp Emerg Care. 2020 Jul 31;1-12.doi: 10.1080/10903127.2020.1792016.**

The study objective was to describe prehospital encounters for patients with a COVID-19 hospital diagnosis and/or COVID-19 EMS suspicion versus those with neither a hospital diagnosis nor EMS suspicion of the disease. All ESO records for 9-1-1 responses between March 1 and April 19, 2020, resulting in transport to a hospital, with at least one ICD-10 outcome returned via the Health Data Exchange were included. COVID-19 EMS suspicion was defined as a documented EMS primary or secondary impression of COVID-19, or indication of COVID-19 suspicion in the prehospital free-text narrative. There were 84,540 EMS patient records with linked hospital ICD-10 codes included, 814 (1%) patients had a COVID-19 hospital diagnosis. Overall, COVID-19 EMS suspicion was documented for 3,204 (4%) patients. COVID-19 EMS suspicion demonstrated a sensitivity of 78% for those with a hospital diagnosis of COVID-19. Among EMS suspected COVID-19 patients, the probability of a COVID-19 hospital diagnosis was 20%. Among those patients for whom EMS did not document suspicion of COVID-19, the probability of not having a hospital diagnosis of COVID-19 was 99.8%. Those with COVID-19 hospital diagnoses were more likely to present with tachycardia, tachypnea, hypoxia, and fever during the EMS encounter. EMS responses for patients diagnosed with COVID-19 were also more likely to originate from a skilled nursing/assisted living facility. EMS PPE (eye protection, mask, or gown) use was more frequently documented on records of patients who had hospital diagnosed COVID-19.

72. **George TP, Chan HK, Crowe RP, Jarvis JL, Jansen JO, Huebinger RM, Wang HE. Clinical characteristics and course of out-of-hospital shock in a national emergency medical services cohort. J Am Coll Emerg Physicians Open. 2020 May 23;1(4):432-439. doi: 10.1002/emp2.12090. PMID: 33000067; PMCID: PMC7493535.**

The study objective was to characterize adult out-of-hospital shock care in a national EMS cohort. The 2018 ESO research dataset was used for this analysis. The study evaluated adult (age ≥18 years) non-cardiac arrest patients with shock, defined as initial systolic blood pressure ≤80 mm Hg. Among 6,156,895 adult 911 responses, shock was present in 62,867 (1.02%; 95% confidence interval = 1.01%-1.03%); 54,239 (86.3%) medical and 5978 (9.5%) traumatic, and 2650 unknown. Medical was more common than traumatic shock in women and older patients. The most common injuries associated with traumatic shock were falls (37.6%) and motor vehicle crashes (18.7%). Mean initial and final medical systolic blood pressure were 71 ± 10 mm Hg and 99 ± 24 mm Hg. Systolic blood pressure increased in 88.8% and decreased or did not change in 11.0%. Mean initial and final trauma systolic blood pressure were 71 ± 13 mm Hg and 105 ± 28 mm Hg; systolic blood pressure increased in 90.4% and decreased/did not change in 9.6%. On fractional polynomial modeling, systolic blood pressure changes were greater and faster for trauma than medical shock.

73. **Jarvis JL, Hamilton V, Taigman M, Brown LH. Using Red Lights and Sirens for Emergency Ambulance Response: How Often are Potentially Life-Saving Interventions Performed? [published**

online ahead of print, 2020 Jul 17]. Prehosp Emerg Care. 2020;1-13. doi:10.1080/10903127.2020.1797963

The study objective was to describe the frequency and nature of 9-1-1 calls that result in potentially life-saving interventions during the call. The 2018 ESO research dataset was used for this analysis. Use of lights and sirens, call nature, and interventions performed were evaluated. The definition of potentially life-saving interventions was developed a priori through a consensus process and included both interventions, medications, and critical hospital notifications. The proportion of calls with lights and sirens response as well as with potentially life-saving interventions performed was calculated. The calculation was performed for total calls as well as stratified by call nature. There were 5,977,612 calls from 1,187 agencies included in the analysis. The consensus process identified 42 potentially life-saving interventions. Over 85% of calls utilized lights and sirens, however only 7% resulted in a potentially life saving intervention. cardiac arrest calls had the highest frequency PLSI (45.0%); followed by diabetic problems (37.0%). Glucose was the most frequently given PLSI, n =69,036. When including multiple administrations to the same patient, epinephrine was given most commonly PLSI, n = 157,282 administrations).

74. Jarvis J., Johnson B., Crowe R.P. Out-of-hospital Assessment and Treatment of Adults with Atraumatic Headache. JACEP Open. 2020; 1–7.

The study objective was to describe the out-of-hospital assessment and treatment of adults with benign headache. Meaningful pain reduction stratified by commonly administered medications was also described. ESO data from January 1, 2018 to December 31, 2018 were analyzed. All 911 responses by paramedics for patients 18 and older with headache were included. Patients with trauma, fever, suspected alcohol/drug use, or who received medications suggestive of an alternate condition were excluded. Out-of-hospital pain scores were documented infrequently and less than one in five patients with initial pain scores >5 received medication. Of the 5,977,612 emergency responses, 1.1% (66,235) had a provider documented primary impression of headache or migraine and 52.5% (34,763) met inclusion criteria. An initial pain score was recorded for 73.5% (25,544) of patients, and 58.5% (14,948) of these patients had multiple pain scores documented. Of the patients with multiple pain scores documented, 53.8% (8,037) of patients had an initial pain score >5. Of these, 7.1% (573) were administered any medication. Among patients receiving a single medication, Fentanyl was the most commonly administered (32.1%, 126). As a group, opioids were the most commonly administered class of drugs (38.9%, 153) and were associated with the largest proportion of clinically significant pain reduction (69.3%,106).

75. Crowe RP, Myers JB, Fernandez AR, Bourn S, McMullan JT. The Cincinnati Prehospital Stroke Scale Compared to Stroke Severity Tools for Large Vessel Occlusion Stroke Prediction. Prehosp Emerg Care. 2020 Feb 4:1-15. doi: 10.1080/10903127.2020.1725198.

The study objective was to determine whether newly-developed LVO stroke scales offer a clinically-meaningful advantage over the Cincinnati Prehospital Stroke Scale (CPSS). ESO Health Data Exchange data from January 1, 2018 and December 31, 2018 was analyzed. CPSS was compared to the Rapid Arterial Occlusion Evaluation (RACE), Los Angeles Motor Scale (LAMS), and the Vision, Aphasia, Neglect (VAN) assessment for LVO prediction. In this large sample of real-world prehospital patient encounters, the CPSS demonstrated similar predictive performance characteristics compared to the RACE, LAMS, and VAN for detecting LVO stroke. There were 13,596 prehospital records with one or more documented stroke scales of interest. Among these, 4,228 patients were diagnosed with stroke. Over half (57%, n = 2,415) of patients diagnosed with stroke experienced an acute ischemic stroke. Of patients with ischemic stroke, 26% (n = 628) were diagnosed with LVO. A CPSS score of 2 or higher demonstrated sensitivity =69% and specificity =78% for LVO. A RACE score of 4 or higher demonstrated sensitivity =63%, specificity =73%. A LAMS score of 3 or higher demonstrated sensitivity =63%, specificity =72% and a positive VAN score demonstrated sensitivity =86%, specificity =65%. Comparing the area under the ROC curve for each scale revealed no statistically significant differences in discriminative ability for LVO stroke.

76. Nwanne T., Jarvis J., Barton D., Donnelly J.P., Wang H.E. Advanced airway management success rates in a national cohort of emergency medical services agencies, Resuscitation, Volume 146, 2020, Pages 43-49.

The study objective was to characterize advanced airway management performance in a national cohort of EMS agencies. ESO data from January 1, 2011, to December 31, 2015 were analyzed. Advanced airway management techniques were categorized as conventional endotracheal intubation (cETI), neuromuscular blockade assisted intubation (NMBA-ETI), supraglottic airway (SGA), and cricothyroidotomy (needle and open). AAM success rates varied by airway technique and patient subset. Overall AAM success was 89.1% (95% CI: 88.8-89.3%) across all patients and techniques. Intubation success rates varied by technique; cETI (n = 38,004; 76.9%, 95% CI: 76.5-77.3%), NMBA-ETI (n = 6768; 89.7%, 88.9-90.4%). SGAs were used both for initial (n = 9461, 90.1% success, 95% CI: 89.5-90.7%) and rescue (n = 5994, 87.3% success, 95% CI: 86.4-88.1%) AAM. Cricothyroidotomy success rates were low: initial cricothyroidotomy (n = 202, 17.3% success, 95% CI: 12.4-23.3%), rescue cricothyroidotomy (n = 85, 52.9% success, 95% CI: 41.8-88%). AAM success rates varied by patient subset: cardiac arrest (n = 35,782; 91.7%, 95% CI: 91.4-92.0), medical non-arrest (n = 17,086; 84.7%, 84.2-85.2%); trauma (n = 4341; 84.3%, 83.1-85.3%); pediatric (n = 1223; 73.7%, 71.2-76.2%).

77. Wang H.E., Donnelly J.P., Barton D., Jarvis J. Assessing advanced airway management performance in a National Cohort of Emergency Medical Services Agencies. Annals of emergency medicine. 2018 May 1;71(5):597-607.

The study objective was to assess variations in advanced airway management and conventional intubation performance in a national cohort of EMS agencies. ESO data from January 1, 2011, to December 31, 2015 were analyzed. EMS advanced airway management and initial conventional intubation performance varied widely. During the study period, there were 550 EMS agencies performed 57,209 advanced airway management procedures. Among 401 EMS agencies with greater than or equal to 10 advanced airway management procedures, there were a total of 56,636 procedures. Median reliability-adjusted and risk-standardized EMS agency advanced airway management success was 92.9% (interquartile range 90.1% to 94.8%; minimum 58.2%; maximum 99.0%). There were 56 advanced airway management low-performing and 38 high-performing EMS agencies. Among 342 agencies with greater than or equal to 10 initial conventional intubations, there were a total of 37,360 initial conventional intubations. Median reliability-adjusted and risk-standardized EMS agency initial conventional intubation success was 77.3% (interquartile range 70.9% to 83.6%; minimum 47.1%; maximum 95.8%). There were 64 initial conventional intubation low-performing and 45 high-performing EMS agencies.

78. Jarvis, J., Barton, D., Wang, H.E., Defining the Plateau Point: When are further attempts futile in out-of-hospital advanced airway management? Resuscitation, 2018. 130: p. 57-60.

The study objective was to characterize the number of attempts required to achieve advanced airway management success. ESO data from January 1, 2011 and December 31, 2015 were analyzed. There were 57,209 patients who had at least one Advanced Airway Management attempt included in the analysis. Results indicated that Multiple attempts were often needed to accomplish successful advanced airway management. The number of attempts needed to accomplish advanced airway management varied by advanced airway management technique with cardiac arrest intubation having a success plateau of 4 attempts to reach 91.5% overall success, medical non-arrest intubation having a success plateau of 3 attempts to reach 79.2% overall success, traumatic non-arrest intubation having a success plateau of 3 attempts to reach 75.8% overall success, rapid sequence intubation having a success plateau of 4 attempts to reach 95.8% overall success, sedation-assisted intubation having a success plateau of 3 attempts to reach 85.3% overall success, and supraglottic airways having a success plateau of 3 to reach 92.8% overall success.

PUBLISHED/PRESENTED ABSTRACTS

1. **Jessica Rosner, DrPH; Daisy Banta, MPH; Remle Crowe, PhD, NREMT; Edward C. Preusser, MSBA J. Brent Myers, MD, MPH; Antonio R. Fernandez, PhD, NRP. A Description of Characteristics and Outcomes for Injured Patients Receiving Prehospital Whole Blood Using a Statewide Linked EMS and Trauma Registry Dataset. NASEMSO 2025.**

The objective of this study was to evaluate Virginia prehospital trauma patients who received whole blood by ground EMS. This retrospective study evaluated EMS incidents from 1/1/2021-12/31/2024 in the Virginia EMS Data Repository. 9-1-1 responses with documentation of whole blood administration performed by an EMS clinician were included. Air medical responses were excluded. Patient outcome data was obtained by linking records to the Virginia Statewide Trauma Registry. 70 patients transported by 10 ground EMS agencies were included in the study. Overall, 47.1% were injured by firearm discharges and 17.1% by motor vehicle crashes. Median time from EMS arrival on-scene to blood administration was 16.1 minutes (Interquartile range [IQR]: 11.3-25.0). 94.3% were transported to trauma centers, median transport time to trauma centers was 13.0 minutes (IQR: 12.1-26.0). The most common mechanism of injury was penetrating (68.6%). CPR and tourniquet application was performed for 20.0% and 11.4%, respectively. Most (80.0%) patients also had crystalloids administered. Tranexamic acid and calcium were administered to 15.7% and 10.0%, respectively. The median systolic blood pressure (SBP) prior to blood administration was 102 mmHg (IQR:80-130), compared to 113 mmHg (IQR: 85-132) post-administration. The median heart rate prior to blood administration was 100 (IQR: 82-122), compared to 102 (IQR: 82-116) post-administration. The median injury severity score (ISS) was 17 (IQR: 5-25). Among the 68 patients with available hospital outcome data, 70.6% survived to hospital discharge. These patient's median ISS of 16.5 (IQR: 5-26) compared to 19 (IQR: 4-25) among those who died. Discharge location information was available for 44 surviving patients, most were discharged home (72.7%).

2. **James E. Winslow, Tom Mitchell, James A. Hood, Alison Treichel, J. Brent Myers, Remle P. Crowe, Jennifer K. Wilson, Christopher Montera, Antonio R. Fernandez. Describing Prehospital Maternity and Neonatal Care in North Carolina. NASEMSO 2025.**

The objective of this study was to Describe maternity care and neonatal resuscitation by Emergency Medical Services in North Carolina. This analysis included all records submitted to the North Carolina Office of Emergency Medical Services that had a requested service of 9-1-1 response or Emergency Response (Primary Response Area) and a provider impression ICD 10 code or protocol used during the EMS event that was consistent with pregnancy, childbirth or neonatal resuscitation. The study period was January 1, 2022-December 31, 2024. During the study period, there were 5,027,518 emergency 9-1-1 EMS activations and 8,836 that met inclusion criteria. The number of 9-1-1 activations increased 7% (2022: n=1,664,757; 33.1%; 2023: n=1,576,820; 31.4%; 2024: n=1,785,941; 35.5%) from 2022 to 2024 while the number of maternity care and neonatal resuscitation activations increased 30% (2022: n=2,561; 29.0%; 2023: n=2,936; 33.2%; 2024: n=3,339; 37.8%). There were 7,063 patients with other pregnancy related conditions that met inclusion criteria, 3% of these occurred in Maternity Care Deserts. There were 1,196 EMS activations to care for a mother during labor and/or delivery. There were 577 neonates included in this study; about 85% occurred in the home/residence. While transport times were increased in maternity care deserts, this did not appear to lead to an increase in prehospital deliveries overall nor deliveries following patient transport. One in five neonates included in this study required resuscitation. Considering the projected overall population growth in NC, strategies to prepare EMS clinicians to care for this increasing patient population of low frequency, high acuity calls should be investigated.

3. **Chettie Greer, Christopher T.E. Price, Mary Waldo, Alison Treichel, Remle P. Crowe, J. Brent Myers, Jennifer K. Wilson, Christopher Montera, Antonio R. Fernandez. Quantifying and Describing Pediatric Patients who received Emergency Care from North Dakota EMS for Suicide or Self-Harm. NASEMSO 2025.**

The objective of this study was to quantify and describe EMS encounters for suicide or self-harm among pediatric patients in ND from January 1, 2022 to December 31, 2024. This retrospective analysis evaluated all 9-1-1 responses submitted to the ND EMS Repository for patients less than 18 years of age with a provider impression (eSituation.11 or eSituation.12) and/or cause of injury (eInjury.01) consistent with suicide or self-harm. The number of pediatric 9-1-1 emergency responses for suicide or self-harm have increased faster than the overall 9-1-1 call volume in ND over the study period. One in every 25 pediatric 9-1-1 calls in ND were for suicide or self-harm and the overwhelming majority of patients were female. These calls most often occurred in the home and EMS interventions were rare. Strategies to prepare EMS clinicians with the knowledge, tools, and skills to care for this patient population should be investigated. Future research should seek to identify the impact these calls have on EMS clinician burnout and workforce longevity.

4. Sandra M. Lopez, MD,, Madeleine Mitcham, MA, Justin Preddy, Colby Redfield, MD, Ali Treichel, MPH ,Scott Bourn, PhD, RN. Current Trends in Oxytocin Use in the Out-of-Hospital Setting. AAEM 2025 FL.

The objective of this study was to describe frequency of use and characteristics among patients who receive oxytocin during an EMS encounter. This descriptive study examined 13,957,073 prehospital electronic health care records from 3,068 agencies from January 1,2023-December 31, 2023 from the ESO Data Collaborative. Among 6,125 identified childbirth-related encounters, only 111 patients (1.8%) received oxytocin. Most of these were 9-1-1 responses (66%) or interfacility transfers (30%). EMS administered oxytocin in 62% of cases, while 38% received it prior to EMS arrival. The median scene and transport times were 24.5 and 17.5 minutes, respectively. The majority of encounters occurred in urban areas (84%) and in communities with lower social vulnerability (65%). The median patient age was 28, with most identified as white non-Hispanic (51%), followed by Black (34%) and Hispanic (10%) patients.

5. Kobe Wright, Michael Kaduce, Alison Treichel, Remle Crowe, Baxter Larmon. Evaluating Pelvic Circumferential Compression Device Use in Prehospital Pelvic Fracture Management and Patient Outcomes EMS EXPO 2024 and NAEMSP 2025.

This study worked backward from hospital-confirmed pelvic fractures to evaluate patient and mechanism characteristics of prehospital PCCD usage. A large-scale retrospective review was conducted using de-identified data from the 2022 ESO Data Collaborative. The inclusion criteria were adults with hospital-confirmed pelvic fractures transported by EMS in 2022. Key variables included patient demographics, injury location, PCCD application, vital signs, and hospital outcomes. Evaluation included logistic regression, Wilcoxon rank-sum, and, due to small sampling, post hoc analysis using adjusted residuals. 6,333 patients were included, of which 4,245 (67.18%) were 60+ y.o. with 75+ y.o. females comprising 2,281 (36.01%) of all cases. 75 (1.2%) patients had prehospital PCCD application documented. PCCDs were applied less than expected in patients who were 75+ y.o., female, at home, experiencing a pubic fracture, or who fell. Conversely, they were applied more than expected in patients who were < 30 y.o., male, experiencing an acetabulum or unstable pelvic ring fracture, or involved in a traumatic injury. PCCD application was higher in those with signs of critical injuries, but no significant difference was observed in hospital stay or mortality. The only significant effect detected with PCCD use was pain reduction greater than expected. The

odds of a disrupted pelvic ring fracture were higher in traffic accidents (OR: 1.64, CI: 1.19–2.27), traumatic injuries (OR: 1.84, CI: 1.23–2.75), patients with a shock index (SI) >0.9 (OR: 1.83, CI: 1.44–2.34), and 46– 60 y.o. males (OR: 2.02, CI: 1.33–3.04), however, 75+ y.o. females who fell were among the largest subgroups for stable (n = 62) and unstable disrupted pelvic ring fractures (n = 6). Overall mortality was 2.4%, with higher odds in 46+ y.o. males, 75+ y.o. females, traffic accidents, and patients with signs of critical injuries (SI > 0.9, SpO2 < 94%, GCS< 15).

6. **Sydney E. Jarvis, Jeffrey L. Jarvis, Jamie Kennel. The Association Between Patient Race and Prehospital Drug Assisted Airway Management Approach. EMS EXPO 2024 and NAEMSP 2025.**

The aim of this research was to determine the association between patient race and prehospital DAAM approach. The 2022 ESO Data Collaborative dataset was used to analyze patients without cardiac arrest intubated during a 9-1-1 activation. Records with missing race or from agencies with fewer than ten RSI intubations were excluded. Four DAAM approaches were analyzed using the following definitions based on medications administered prior to the initial ETI attempt: RSI (sedative and paralytic), SO (sedative only), PO (paralytic only), and those who received no medications prior to intubation. We characterized the dataset using descriptive statistics and calculated odds ratios (OR) and 95% confidence intervals, adjusting for age, gender, GCS< 8, ETI indication, SpO2 < 90, SBP < 80, and Social Vulnerability Index, to evaluate the association between race and DAAM approach. Results: Of the 11,140,341 9-1-1 responses in the dataset, there were 52,619 patients with at least one intubation attempt. There were 11,044 patients with documented race who were intubated outside of cardiac arrest. Among the 6,033 patients treated by an agency with at least ten RSI intubations, 4,620 (76.6%) were White, 760 (12.6%) were Black, and 515 (8.5%) were Hispanic. DAAM approaches varied: RSI (71.1%), No Meds (13.9%), SO (13.4%), and PO (1.3%). Black patients had 26% lower odds of receiving RSI than White patients (OR: 0.74, 95% CI: 0.58–0.95), and 65% higher odds of receiving SO (OR: 1.65, 95% CI: 1.24–2.18) than White patients.

7. **Nelea K. Fong, Kobe Wright, Tiffany Phan, Claudia Del Toro, Bengie Alexandre, Yahya Elshawarbi, Sukai Curtis Contreras, Jamie Kennel. Cerebral Vascular Accidents in Underserved Communities Are Missed More Often by EMS Clinicians. EMS EXPO 2024.**

The study objective was to investigate whether limited English proficiency (LEP) status affects the misdiagnosis rate of CVAs by EMS. A quantitative, retrospective study using de-identified electronic patient care report (ePCR) data from the 2022 ESO Data Collaborative was conducted. Adult patients transported by EMS with a CVA diagnosis documented by the ED were included and unresponsive patients, non-9-1-1 calls, and cardiac arrests were excluded. The outcome variable was the match frequency of CVA diagnosis between prehospital and ED clinicians. LEP status was determined if “language barrier” was selected on the prehospital ePCR. Bivariate and multivariable regression models to compare outcomes among patients with and without LEP was conducted. 12,141 patients diagnosed with a CVA by the ED were identified. EMS correctly identified a CVA in 6,081 (50.1%) of these patients, with similar diagnostic accuracy rates between LEP patients (n = 328, 49.1%) and non-LEP patients (n = 11,813, 50.1%). In the adjusted models for all CVA types, LEP status did not significantly relate to EMS diagnostic accuracy. However, Hispanic patients were less likely to be diagnosed correctly by EMS compared to white patients (aOR: 0.71, CI: 0.59–0.86), and patients with the lowest social vulnerability index (SVI = 4) were less likely to be diagnosed correctly compared to patients with an SVI =1 (aOR: 0.86, CI: 0.78–0.96). For ischemic strokes (n ¼ 10,208), EMS diagnosis accuracy was significantly lower for both Black (aOR: 0.87, CI: 0.78–0.97) and Hispanic patients (aOR: 0.73, CI: 0.60–0.91), as well as patients with a SVI = 3 (aOR: 0.87, CI: 0.78–0.97) and SVI = 4 (aOR: 0.78, CI: 0.69–0.87), compared to patients with a SVI =1.

8. **Jeffrey L. Jarvis, Sydney E. Jarvis, Jamie Kennel. The Association Between Prehospital Drug Assisted Airway Management Approach and Intubation First Pass Success. EMS EXPO 2024 and NAEMSP 2025.**

The primary objective was to determine the association between prehospital DAAM approach and first pass success using the 2022 ESO Data Collaborative data set. Patients treated during a 9-1-1 response who underwent at least one intubation attempt were included. Patients in cardiac arrest were excluded. DAAM approach was categorized according to the medications they received before

the initial ETI attempt: RSI received both a sedative and paralytic, SAI received only a sedative, Paralytic Only (PO) received only a paralytic, and received no medications. Descriptive statistics and odds ratios (OR) with 95% confidence intervals, adjusted for age, gender, race, intubation indication, laryngoscope type, GCS < 8, and initial hypoxia to assess the association between DAAM approach and first pass success were calculated. Of the 11,140,341 9-1-1 responses in the dataset, there were 52,619 patients with at least one intubation attempt. Of these, 39,735 (75.5%) were intubated for cardiac arrest. Among the 12,884 patients intubated for reasons other than cardiac arrest, 7,484 (58.1%) were male, 8,442 (65.5%) were White, and 3,095 (24.0%) were intubated for traumatic conditions. 96% were adults and 42.8% were intubated with a video laryngoscope. Overall, first pass success was 75.3%. DAAM approaches included RSI (51.1%), No Meds (29.7%), SAI (17.8%), and PO (1.3%). Compared with no medication, the adjusted OR (95% CI) were higher for RSI, 2.34 (2.11–2.60) and PO, 2.59 (1.70–4.08), and similar for SAI, 1.10 (0.98–1.25). RSI was also associated with higher first pass success when compared with SAI: 2.12 (1.90–2.38).

9. **Iv Godzdanker, Scott Kostolni, Linh Nguyen, Tamara Klindt, Sharon Long, David Wampler, Lawrence Brown. Whole Blood versus Blood Components in Prehospital Care. EMS EXPO 2024 and NAEMSP 2025.**

This study compared the frequency of adverse events, and outcomes, for prehospital patients receiving whole blood or blood components analyzing the ESO Data Collaborative for 2019–2023, patients 8 to 100 years old who received either WB or BC. Interfacility transports, patients receiving blood products prior to EMS arrival, and pre-arrival cardiac arrest patients were excluded. Adverse events were defined as: prehospital diphenhydramine or 1:1,000 epinephrine administration, emergency department (ED) documented transfusion reactions, and ED or hospital documented deep vein thrombosis (DVT), pulmonary embolism (PE) or stroke. The incidence of adverse events and ED/hospital mortality for patients receiving WB vs. BC were compared using Fisher's exact test or chi-square analysis. Logistic regression was used to compare mortality adjusting for age, presenting condition/mechanism, ground vs. air medical agency, and transport time. There were 1,515 eligible patients who received WB and 475 who received one or more BC (PRBC & FFP = 103; PRBCs only = 313; FFP only ¼ 20; unspecified = 39). Five WB patients and no BC patients received prehospital diphenhydramine (0.3% vs. 0.0%, p ¼ 0.599); no patients received 1:1,000 epinephrine. ED/hospital diagnosis data were available for 381 WB and 129 BC patients. There were no reports of transfusion reactions. One WB patient had a DVT (0.3% vs. 0.0%, p = 0.999) and two WB patients had a PE (0.5% vs. 0.0%, p = 0.999). There were no reported strokes. Observed mortality was greater in the WB group (19% vs 7%), but after adjustment for patient and encounter characteristics, the difference was not statistically significant (aOR =2.0, CI: 0.8–5.5).

10. **George Koshy, Andrew Kuznetsov, Shaylin Dalton, Earl Culvey, Antonio Fernandez, Douglas F. Kupas. Validating the Use of the RPM Score for Triage of Injured Patients in a Current Trauma Population. EMS EXPO 2024 and NAEMSP 2025**

This study aimed to validate the RPM score as a predictor of mortality in a large, recent cohort of US trauma patients. This retrospective study analyzed prehospital and hospital data from the ESO Research Collaborative 2022 dataset. Inclusion criteria included patients of all ages with a 9-1-1 response who were transported and classified as a trauma by EMS practitioners. The independent variable is prehospital RPM score, which was calculated using first available prehospital values for respiratory rate, heart rate, and motor score. The individual patient RPM scores were correlated with mortality rate. Prehospital deaths, interfacility transports, and canceled calls were excluded. The primary outcome measure is mortality, with a secondary outcome measure of hospital length of stay (LOS). Individual RPM scores were analyzed for mortality within subgroups of traumatic mechanisms: motorized vehicle/aircraft accidents, bicycle/pedestrian accidents, shooting/stabbings, and falls. 1,025,414 patients were transported in response to 9-1-1 calls with traumatic injury, with 219,495 of these with hospital outcome data available. The mortality rate associated with each level of RPM score is: 0 = 94.8%; 1 = 90.5%, 2 = 94.6%, 3 = 77.6%, 4 = 84.7%, 5 = 58.2%, 6 = 50%, 7 = 37.1%, 8 = 25.1%, 9 = 5.1%, 10 =1.5%, 11 = 1.1%, 12 = 0.4%.

11. **Matt R. Shaw, Iv Godzdanker, Alison Treichel, Beth G. McManis, Remle P. Crowe. A comparison of prehospital hypotension vs elevated shock index to predict mortality among injured patients. SAEM 2024.**

The study objective was to compare prehospital hypotension and elevated shock index for predicting mortality among injured patients. We conducted a retrospective analysis using the 2021 ESO Data Collaborative national research database, consisting of records from 1956 EMS agencies. Of these, 31% participate in a bi-directional health data exchange linking EMS data with hospital outcomes via HL7 messaging. We included all 9-1-1 encounters for adult patients (>17 years) with documented trauma, who were transported by EMS and had linked hospital outcome data. We excluded patients with cardiac arrest prior to EMS arrival and pregnancy. Our independent variables were hypotension (SBP < 90 mm Hg) and elevated shock index (SI > 1.0), based on first EMS vital signs. Our outcome was 24-h hospital mortality. We compared sensitivity and specificity using McNemar's test and we used the DeLong method to compare area under the receiver operating curve (AUROC). We used univariable logistic regression to assess odds of 24h mortality. We analyzed records for 196,043 injured patients. The median age was 59 years (IQR: 36–77) and 53% (104,345) were female. Initial prehospital SBP < 90 was present in 1.2% (n = 2373) and SI > 1 in 3.5% (6767). Of patients with elevated shock index, 20.0% (n = 1356) also had hypotension. Overall, 24 h mortality was 0.3% (n = 488). SI > 1 had higher sensitivity for 24 h mortality compared to SBP < 90 (31.2% vs. 22.3%, $p < 0.01$), but lower specificity (96.8% vs. 98.9%, $p < 0.01$). AUROC was higher for SI > 1 (0.64, 95% CI: 0.62–0.66) compared to SBP < 90 (0.61, 95% CI: 0.59–0.62); $p < 0.01$. Patients with SI > 1 (OR: 13.6, 95% CI: 11.2–16.5) or SBP < 90 (OR:26.9 95% CI: 21.6–33.5) were at increased odds of 24 h mortality.

12. **Meghan Hewlett, Remle P. Crowe, James Ford, Renee Y. Hsia. Disparities in intra-arrest emergency medical services transport by neighborhood socioeconomic vulnerability. SAEM 2024.**

The aim of this study was to investigate whether neighborhood socioeconomic vulnerability profiles are associated with intra-arrest transport in adults with OHCA. We analyzed EMS records for adult patients in the United States with non-traumatic OHCA and an attempted resuscitation between January 1, 2022 and December 31, 2022, from the ESO Data Collaborative. Our independent variable was the Centers for Disease Control and Prevention Social Vulnerability Index (SVI). We stratified neighborhoods into quartiles based on SVI percentile, with higher percentiles indicating greater vulnerability. Using multivariable generalized estimating equation modeling, we assessed the association between neighborhood SVI quartiles and intra-arrest transport. Secondary outcomes included return of spontaneous circulation (ROSC) and survival to hospital discharge. Among 65,334 patients included, the median age was 65 years (interquartile range: 52–76); 63% were male; 38% received bystander resuscitation; and 38% underwent intra-arrest transport. Adults from neighborhoods in the most vulnerable SVI quartile had a higher incidence of intra-arrest transport (41% vs. 33%, $p < 0.01$) and a lower incidence of prehospital ROSC (27% vs. 29%, $p < 0.01$) relative to those in the least vulnerable SVI quartile. Among transported patients, survival to hospital discharge was lower in adults who received intra-arrest transport versus those who received sustained on-scene resuscitation (5% vs. 24%, $p < 0.01$). After adjustment, neighborhoods in the most vulnerable SVI quartile had greater odds of intra-arrest transport (1.35, 95% CI: 1.15–1.29). Intra-arrest transport was associated with a ten-fold increase in mortality odds after adjustment (10.33, 95% CI: 7.74–13.79).

13. **Lakota Cheek, Robert H. Schmicker, Remle P. Crowe, Amanda West, Jason McMullan, Robert Dunne, Emily Goren, Karen N. Adams, Jeanne Poole, Antje Hoering, Brent Myers, Graham Nichol. Are rurality or deprivation associated with variation in emergency medical services care in patients with myocardial infarction? SAEM 2024.**

The purpose of this study assess if rurality or area deprivation of the neighborhood where STEMI occurred explained variation in EMS process and outcomes using a contemporary national registry.

We analyzed data from >2500 EMS agencies collated by ESO Inc. (Austin, TX) to describe EMS care up to transfer of care to a receiving ED without manual or duplicate data entry. Health data exchange with participating receiving hospitals describes care up to discharge. Included were patients with STEMI treated by EMS from Jan 1, 2022, to Dec 31, 2022. STEMI was defined by provider impression or ST-elevation on field electrocardiogram. Rurality was defined by rural-urban commuting area codes. Deprivation was defined by area deprivation index. The key process variable was EMS transport time. The primary outcome was survival to discharge. Generalized estimating equations adjusted for baseline characteristics. Included were 27,270 adults. 33% were in rural or suburban locations and 11% in areas with high deprivation. These were median (interquartile range) age 66 (56, 76) years, 34% female, and 16% Black non-Hispanic. Median transport time was 27 (15, 37) vs. 22 (13, 31) vs. 10 (7, 15) min in rural vs. suburban vs. urban areas ($p < 0.001$). Overall, 89% of patients survived to discharge. Among those with vital status data (n = 6540), adjusted for patient and EMS characteristics, patients with STEMI did not have reduced survival to discharge in rural (OR [95% CI] = 1.4 [0.8, 2.4]) or suburban (1.1 [0.8, 1.4]) areas or in areas of high (OR [95% CI] = 1.0 [0.7, 1.3]) or moderate deprivation (1.0 [0.8, 1.2]). There was no significant interaction between rurality and deprivation ($p = 0.4$).

14. **Diana Marie Bongiorno, Gregory Peters, Margaret E. Samuels-Kalow, Scott A. Goldberg, Remle P. Crowe, Rebecca E. Cash. Racial disparities in prehospital physical restraint and chemical sedation use among behavioral health patients. SAEM 2024.**

The purpose of this research was to investigate the association between patient race/ethnicity and restraint/sedation use during EMS encounters for BHE. This retrospective cohort study used the 2021 ESO Data Collaborative dataset. We included EMS encounters for patients aged 16–90 years with a primary/secondary impression, sign or symptom, or protocol use related to BHE. The primary outcome was any physical restraint and/or chemical sedation (antipsychotic, benzodiazepine, or ketamine). Patient race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic, other (e.g. Asian, multiracial) and unknown. We used mixed effects logistic regression to calculate odds ratio for restraint/sedation use for each patient race/ethnicity group, accounting for clustering by EMS agency and adjusted for age, sex, urbanicity, and community diversity. Among 661,307 included encounters, 46,042 (7.0%) received prehospital restraint and/or sedation (4.5% physical restraint, 3.9% chemical sedation, 1.4% both). Overall restraint/sedation use differed across racial/ethnic groups (e.g. Hispanic, 10.6%; non-Hispanic Black, 7.9%; non-Hispanic White, 6.1%; $p < 0.001$). Patients who were Black, compared to non-Hispanic White, had significantly greater odds of receiving restraint/sedation (e.g. any restraint/sedation: aOR 1.18, 95% CI 1.14–1.21; physical restraint: aOR 1.22, 95% CI 1.18–1.26). There was no significant difference in adjusted odds of any restraint/sedation use for the remaining racial/ethnic groups, compared to non-Hispanic White patients. Clustering contributed substantially to agency-level variation in restraint/sedation use (ICC 0.16, 95% CI 0.15–0.17).

15. **Anjali Misra, Scott A. Goldberg, Kori Zachrison, Remle P. Crowe, Rebecca E. Cash. Emergency medical services agency characteristics associated with documentation of prehospital stroke scale and blood glucose level. SAEM 2024.**

This study aimed to identify EMS agency characteristics associated with high-quality documentation for stroke care, specifically for stroke scale and blood glucose level, to inform focus areas for future intervention. We conducted a cross-sectional evaluation of EMS activations for patients with suspected stroke in the 2019 ESO Data Collaborative, a data set of approximately 8.3 million EMS encounters. We included 911 responses with a field impression of stroke and excluded BLS agencies and activations from acute care facilities. Descriptive statistics and agency-level rates of documented blood glucose and stroke scale were calculated. Low, average, and high rates of documentation were defined as the first, second to ninth, and tenth deciles, respectively. A multinomial logistic regression model was used to calculate relative risk ratios (RRR) and compare agency characteristics between groups. A total of 80,168 encounters for suspected stroke from 862

EMS agencies were included (21.6% fire department-based, 65.1% non-volunteer, 93.6% primarily providing emergency response). The mean agency-level rates for the low, average, and high-documentation groups were 61.7%, 87.6%, and 98.7% for blood glucose, and 4.9%, 69.0%, and 99.6% for stroke scale. For blood glucose, agencies with paid providers were less likely to have low documentation rates (RRR 0.55, 95% CI 0.34–0.88) compared to average. Those with higher rates of urban encounters were less likely to have high documentation rates (RRR 0.68, 95% CI 0.47–0.98). For stroke scale, agencies primarily providing emergency response were less likely to have high documentation rates (RRR 0.31, 95% CI 0.09–1.00). There were no associations between agency characteristics and low documentation of stroke scale.

16. **Rebecca E. Cash, Remle P. Crowe, Anjali Misra, Carlos A. Camargo, Kori Zachrison. Differences in prehospital routing for suspected strokes by patient, community, and emergency medical services agency characteristics. SAEM 2024.**

The study objective was to describe current EMS transport destination practices for patients with suspected stroke. This was a cross-sectional evaluation using a novel dataset of prehospital encounters from the 2019 to 2021 ESO Data Collaborative linked to ED stroke capabilities from the National ED Inventory-USA. Adult patients with suspected stroke (i.e., impression or symptom of stroke or transient ischemia attack or positive stroke scale) documented after a 911 EMS activation and transport to an ED were included. Primary outcome was transport to an ED with acute stroke receiving capabilities (Acute Stroke Ready Hospital [ASRH] designation or higher). Secondary outcome was ED's level of stroke care (ASRH, PSC, Thrombectomy-capable Stroke Center [TSC], CSC). We fit multivariable logistic regression models with cluster robust standard errors to examine associations (aOR, 95% CI) with patient, community, and EMS agency characteristics. There were 169,448 suspected stroke EMS activations from 1566 EMS agencies included, with 147,343 (87%) transported to a stroke-capable ED (9% ASRH ED, 57% PSC, 8% TSC, 26% CSC). Odds of transport to a stroke-capable ED were lower for patients ≥65 years (aOR 0.91, 0.83–0.99); treated by advanced life support crew (0.54, 0.30–0.98); rural location (0.12, 0.06–0.22); and 911 EMS service type (vs. non-911, 0.18, 0.34–0.89). Patients documented as non-Hispanic Black (vs. White, 1.73, 1.19–2.51) or treated by hospital-based agencies (vs. fire, 2.23, 1.01–4.95) had higher odds of transport to a stroke-capable ED. When restricting to patients in urban areas (76%), only the associations for race/ethnicity and agency type persisted.

17. **Michael J. Ward, Brant Imhoff, Kailey Winkler, Jared J. McKinney, Melissa Rubenstein, Lauren Cavagnini, Sunil Kripalani, Remle P. Crowe. Prehospital 12-lead electrocardiogram for acute coronary syndrome varies by community social vulnerability and patient race. SAEM 2024.**

This study sought to examine the association of social determinants of health, as measured by the CDC's Social Vulnerability Index (SVI), with variability in the performance of prehospital 12 lead ECG for patients with suspected ACS. We conducted a retrospective analysis of the 2022 ESO Data Collaborative with de-identified records from over 1300 EMS agencies. We included adults ≥35 years with a prehospital clinical impression of ACS who were transported to the hospital. SVI was linked at the Census tract of the scene encounter and grouped in quartiles with the highest quartile representing communities of greatest vulnerability. Descriptive statistics and a multivariable logistic regression model were used to examine the association of SVI with the prehospital 12 lead ECG performance. Covariates included patient demographics, scene duration, transport duration, highest crew certification level (EMT, paramedic, or other), and agency type (volunteer, paid, or mixed). We analyzed 78,844 EMS encounters for patients with suspected ACS. Median age was 62 (52–74) years, 48.3% were female, and 20% were Black. Most calls occurred in the South Census region (56%), with paid agencies (80%), and a paramedic crew (88%). Compared to communities in the least vulnerable quartile, 2nd (OR 0.93 95% CI: 0.88–0.98), 3rd (OR 0.84 95% CI: 0.79–0.88) and 4th (OR 0.85 95% CI: 0.80–0.90) quartiles were associated with reduced odds of ECG use. Calls for Black (vs. White) patients (OR 0.88 95% 0.84–0.93) and calls for patients with volunteer (vs. paid) EMS agencies (OR 0.32 95% CI 0.26–0.38) also had lower odds of ECG. Paramedic (vs. EMT) crews

(OR 3.64 95% CI: 3.44–3.85) were associated with higher odds of ECG. Additional covariates were not significantly associated with ECG.

18. **Matthew Levy, Remle P. Crowe, Heidi Abraham, Anna M. Bailey, Matt Blue, Joshua B. Holloman6, Jeff Hutchens, Ryan C. Jacobse, Colin Johnson, Jefferson Williams9, Brent Myers, Jerry Overton. Association of an emergency medical services dispatch prioritization system with on-scene and emergency department patient outcomes. SAEM 2024.**

The objective of this study was to assess the relationship between dispatch codes and the need for EMS time critical response based on EMS interventions and ED outcomes. This retrospective multi-center analysis included all 9-1-1 responses between 1/1/2021 and 06/30/2023 from 8 accredited EMS systems using the Medical Priority Dispatch System (MPDS) and a data exchange linking EMS records to ED outcomes. MPDS uses protocols consisting of a number for chief complaint and a determinant letter for acuity from Alpha (minor) to Echo (immediately life-threatening), which served as independent variables. Our outcomes were the proportions of EMS responses classified as time-critical or urgent. A modified Delphi method was used to classify EMS interventions and ED outcomes as time-critical, urgent, or neither. A non-parametric test for trend was used to assess the proportion of responses with time-critical characteristics across determinants. MPDS protocols with at least 120 responses (~1 per week) were further analyzed for the proportion of time-critical EMS responses. We analyzed 1,715,612 EMS responses, of which 72% resulted in transport and 6% included a time-critical EMS intervention. Among transports with linked outcomes (543,883), 9% had a time-critical ED outcome. As determinant acuity increased, the proportion of time-critical responses increased (Alpha: 1%, Echo: 38%, p-trend < 0.01). There were 294 protocols, of which 162 were used at least 120 times. Twenty-two protocols had <1% time-critical EMS responses, accounting for 8.5% of call volume; 7 of 32 Alpha protocols (22%) had time-critical EMS responses >5%.

19. **M Kaduce, A Fernandez, S Bourn, D Calhoun, J Williams, M DeLuca, H Abraham, K Uhi, B Bregenzer, B Larmon, R Crowe, A Treichel, B Myers. Preconceptions and use of automated hospital outcome data as microlearning continuing education by emergency medical services clinicians. SAEM 2024.**

The objective of this study was to evaluate perceptions of automated hospital outcome data. From 10/2023 to 11/2023, using a mixed-methods approach, we surveyed clinicians pre/post a microlearning intervention, offering up to 8 h of Commission on Accreditation for Pre-Hospital Continuing Education (CAPCE) approved CE hours for completion of outcome reviews and associated learning modules. Three high-volume, urban EMS systems participated. Two weeks pre-intervention, EMS clinicians were invited, via their electronic health record, to complete a presurvey including demographics, Likert scale, and open-ended items evaluating rationale for reviewing outcomes. EMS clinicians were notified about the opportunity to earn CAPCE-approved CE. Following the intervention, EMS clinicians were invited to complete a post-survey mirroring the presurvey. Qualitative analyses identified themes among open-ended responses. Quantitative analyses examined perceptions between pre/post-surveys and intervention participation. Among 843 clinicians who accessed the ePCR during the study period, 217 responded to the presurvey. Among the 67 who completed the open-ended items, three dominant themes included: Enhance Personal Confidence/Competence (43%), Acquire Personal Knowledge (39%), and Operations (21%). The most endorsed rationale for reviewing outcomes included improving clinical knowledge (95%), improving patient care (94%), and knowing whether care made a difference (93%). Nearly all (91%) reported being more likely to review outcomes if CE were awarded. 211 opted to participate in the intervention, 98 (46%) completed required registration for CAPCE CE, and 56 (27%) earned CE. 152 responded to the post-survey. The percentage who agreed that reviewing outcomes improves job satisfaction rose from 89% to 95% between pre/post surveys.

20. **S. Ramgopal. Test characteristics of age-adjusted vital sign abnormality thresholds to predict in-hospital outcomes among children transported by emergency medical services. PAS 2024.**

21. **Tanner Smida, Sarah Suchko, Remle P. Crowe, James J. Menegazzi, James Scheidler, Michael Shukis, P.S. Martin, James Bardes, David D. Salcido. The Association of Re-Arrest with Clinical, Treatment, and Demographic Characteristics in a National Dataset. NAEMSP 2024, Austin TX.**

In this analysis, we aimed to identify clinical, treatment, and demographic characteristics associated with rearrest at the encounter and agency levels. Adult non-traumatic cardiac arrest patients who achieved ROSC following EMS resuscitation in the 2018–2021 ESO research datasets were included in this retrospective cohort study. We excluded patients with documented DNR/POLST and those who achieved ROSC after bystander CPR only. We classified patients as having experienced rearrest if they had non-perfusing rhythms at hospital arrival or if they had CPR initiation, administration of ≥1 milligram of epinephrine, or defibrillation after the first ROSC time. Multivariable logistic regression modeling was used to evaluate the association between rearrest and case characteristics. Linear regression modeling was used to evaluate the association between agency-level survival to discharge to home and rearrest rate. Among the 53,027 included patients, 16,116 (30.4%) experienced rearrest. Factors associated with rearrest included longer response intervals (aOR: 1.03 [1.02,1.03] per min.), longer 'low-flow' intervals (aOR: 1.007 [1.004, 1.009] per min.), witnessed OHCA (aOR: 0.80 [0.76,0.84]), and bystander CPR (aOR: 0.94 [0.89,0.99]). In comparison to amiodarone administration, lidocaine administration was associated with increased odds of experiencing a shockable rearrest (aOR: 1.33 [1.08,1.63]). Among agencies that treated >30 patients with outcome data, the agency-level rate of rearrest was variable (range: 11%–44%) and inversely associated with agency-level survival (coef: −0.39 [−0.58, −0.21]).

22. **Sara M. Niederberger, James J. Menegazzi, Remle P. Crowe. Naloxone Administration is Associated with Improved Survival and ROSC in PEA Out-of-Hospital Cardiac Arrests. NAEMSP 2024, Austin TX.**

This study sought to compare rates of survival and ROSC between OHCA cases receiving any naloxone versus those that did not. We used EMS records from a large, retrospective electronic health record database spanning over 1,300 agencies across the US between 2019–2020. We included OHCA cases with all recorded etiologies of cardiac arrest who received CPR by advanced life support clinicians for 60 min or less. Cases were stratified by presenting rhythm (VF/VT, PEA, asystole) for analysis. The outcomes of survival to hospital discharge and prehospital ROSC were compared by naloxone use status using propensity score matching and logistic regression controlling for many factors known to predict OHCA outcomes, including patient demographics, witnessed status, bystander CPR, and length of resuscitation. We analyzed 29,821 records, where 1,304 (4.37%) were identified as having the etiology of OHCA as drug overdose but an additional 2,794 cases (4,098 cases or 13.7% total) received naloxone without being identified as a drug overdose. Before matching, 15.0% of cases presented in VF/VT, 62.9% presented in asystole, and 20.5% presented in PEA. The overall rate of survival to hospital discharge was 8.04% and any prehospital ROSC was 20.8%. After propensity score matching, naloxone was associated with improved survival and ROSC for cases presenting in PEA [unadjusted odds ratios (95% CI): survival: 1.73 (1.27–2.35); ROSC: 1.35 (1.07–1.70)]. There were no statistical differences in either outcome for patients presenting in VF/VT or asystole.

23. **Christopher T. Richards, Laura Syori, Remle P. Crowe, Heidi Sucharew, Jason T. McMullan. Stroke Recognition by Emergency Telecommunicators and on-Scene EMS Practitioners is Associated with a Higher Odds of Favorable Hospital Discharge. NAEMSP 2024, Austin TX.**

The study objective was to describe the concordance of stroke recognition among emergency telecommunicators, on-scene EMS practitioners, and receiving hospitals. We performed a retrospective analysis of linked EMS and hospital records in the 2021 ESO Data Collaborative Dataset, using the subset of 608 agencies participating in a bi-directional data exchange with direct linkage to hospital records, including discharge diagnoses and dispositions. We included emergency ground transports of adults in which the dispatch impression, EMS impression, or emergency

department or hospital diagnosis (ICD-10) was stroke or TIA. Discharge to home or short-term rehabilitation were considered favorable hospital dispositions. Concordance of stroke recognition was measured by percent agreement. Univariable odds ratios and 95% confidence intervals (95%CI) were used to assess the association between prehospital recognition and hospital disposition. We analyzed 226,090 encounters. Median age was 59 years, 52% were female, and 38% were non-White. Of patients with confirmed stroke or TIA (n = 29,796), on-scene EMS practitioners and emergency telecommunicators both identified stroke in 13.2%, with neither identifying stroke in 46.6%. Of 25,461 patients who were transported from home or a community site (i.e., not an assisted living facility), the odds of a favorable hospital disposition were 1.43 (95%CI 1.34–1.52) if the on-scene EMS practitioner recognized stroke, 1.55 (95%CI 1.41–1.70) if the emergency telecommunicator recognized stroke, and 1.80 (95%CI 1.62–2.01) if both the emergency telecommunicator and on-scene EMS practitioner recognized stroke.

24. **Dominic J. Gregorio, Eric Melnychuk, Remle P. Crowe, Heather Dorman, Douglas F. Kupas. Intracranial Hemorrhage Risk among Older Adults Taking Anticoagulant Medications and Transported by Emergency Medical Services for Ground-Level Falls. NAEMSP 2024, Austin TX.**

The purpose of this study was to detect ICH risk differences in older ground-level fall victims based on reported exposure to anticoagulants or related drugs. This retrospective cohort study sampled patient care records from the 2022 ESO Data Collaborative. We included 9-1-1 encounters for older adults (≥55 years) injured by ground-level falls and not meeting available national trauma triage criteria except anticoagulant use. The primary outcome was ICH diagnosis at destination, and the secondary outcome was death before discharge. The exposure group included patients with any anticoagulant, antiplatelet, or thrombolytic medication on EMS-entered patient medication lists. We calculated risk ratios and confidence intervals for ICH and mortality. Out of 214,054 included patients, 158,410 (74.0%) were transported by the documenting crews. Outcomes were available in 36,314 records selected for analysis: median age was 78 and 64.9% were female. Of the 12,250 (33.7%) reportedly taking anticoagulants, antiplatelets, or thrombolytics, there were 318 (2.6%) ICHs and 105 (0.9%) deaths. Of 24,064 not taking such medications, 485 (2%) had ICH, and 191 (0.8%) died. Relative risk (95% CI) was 1.29 (1.12, 1.48) for ICH and 1.10 (0.87, 1.39) for mortality.

25. **Andrew Bouland, Stephen Taylor, Julian Gordon, Juan March. Preventing Sudden Ambulance Death Syndrome: Analysis of Initial Vital Signs and Time to First Intervention. NAEMSP 2024, Austin TX.**

This study aimed to identify which non-traumatic patients are at risk for SADS and assess whether early intervention decreases its incidence. This retrospective study used the 2019 ESO Data Collaborative. Binomial logistic regression and t-tests were analyzed for association of first vital signs and time to first treatment to patient arrest. Inclusion criteria were 9-1-1 paramedic service, no cardiac arrest or EMS witnessed arrest, and initial vital signs of SpO2 < 90 or RR (4–8 or >28) or HR (< 50 or >150) and MAP (30–59). Age <18, trauma, pregnancy, and patients who arrested within 2 min of EMS arrival were excluded. 181,822 patients met the inclusion criteria for critical vital signs: 5118 arrested. The regression model assessed the effects of age, race, MAP, SpO2, HR, RR, and time to first treatment on the likelihood of arrest. The model was statistically significant, $p < 0.001$. and described 42.3% of the variance. The AUROC curve was 0.850, 95% CI [0.82, 0.89]. Four of the predictor values were significant for arrest: low RR OR = 1.89, 95% CI [1.14,3.12], low HR OR = 6.88 more likely, 95% CI [4.2,11.3], critical SpO2 < 90 OR = 4.32 times more likely, 95% CI [2.66,7.01]. Age, race, and MAP were not significant predictors. For each minute delay to first treatment, there was an associated 4.4% (OR = 1.04) increase in arrest, $p = 0.004$, 95% CI [1.01,1.07]. Mean time to first intervention for arrested patients was 7.05 min, 95% CI [6.82,7.28].

26. **Antonio R. Fernandez, Remle P. Crowe, Dave Duncan, Corey M. Slovis, Alison Treichel, Scott S. Bourn, J. Brent Myers. Comparing Prehospital Adenosine Initial Dosing of 6 mg versus 12 mg for Presumed Paroxysmal Supraventricular Tachycardia. NAEMSP 2024, Austin TX.**

This study evaluated the association of the two common adenosine dosing regimens (6 mg and 12 mg) with prehospital patient improvement, hospital admission, complications, and death. This retrospective observational study included all 9-1-1 responses with prehospital adenosine administration between 1/1/2022 and 12/31/2022 from the ESO Data Collaborative. Outcomes included EMS clinician documented patient response (improved v. unchanged/worse) to the initial dose, emergency department (ED) dispositions, CPR/cardioversion/pacing after any administration, and death. Descriptive statistics and univariate odds ratios were used to compare outcomes for patients who received an initial adenosine dose of 6 mg versus 12 mg. We analyzed 11,245 patients who received adenosine from 1,350 EMS agencies. Most received an initial dose of 6 mg (70%, n = 7,825), while 30% (3,314) received an initial dose of 12 mg. Initial pulse rate and systolic blood pressure were similar between groups. Nearly half in the 6 mg group (48%, n = 3,746) received additional doses, compared to 25% (n = 815) in the 12 mg group. An initial dose of 12 mg was associated with 55% increased odds of prehospital improvement (OR: 1.55, 95%CI: 1.41–1.69). Cardioversion (5%, n = 533), pacing (< 1%, n = 3), and CPR (< 1%, n = 44) were rare. There was no difference in the need for cardioversion or pacing between groups (p > 0.05). More patients in the 12 mg group received CPR (6 mg: 0.2%, n = 19 vs. 12 mg 0.7%, n = 22; p = 0.001). Amongst EMS-transported patients, 25% (2,732) had available ED dispositions. An initial dose of 12 mg was associated with a 20% reduction in odds of admission (OR: 0.80, 95%CI: 0.68–0.95). In total, 2% (48) who received prehospital adenosine and had available outcome data died. There was no difference in mortality between groups (OR: 0.91, 95%CI: 0.48–1.71).

27. **Holden Wagstaff, Remle P. Crowe, Scott T. Youngquist, Hill Stoecklein, Yao He, Alison Treichel, Jennifer J. Majersik. Numerical CPSS versus LVO Screening Tools for Prehospital Identification of Large Vessel Occlusion Stroke. NAEMSP 2024, Austin TX.**

The study aimed to compare stoke scales used both nationally and internationally. Using the ESO research database, we retrospectively analyzed prehospital patient care records with linked hospital data from 746 EMS agencies in the United States from January 2022 to December 2022. The CPSS was compared to the Cincinnati Stroke Triage Assessment Tool (CSTAT), the Field Assessment Stroke Triage for Emergency Destination (FAST-ED), and the Balance Eyes Face Arm Speech Time (BE-FAST). The optimal prediction cut-points were determined by intersecting the sensitivity and specificity curves for each scale. To compare the discriminative abilities of each scale among those diagnosed with LVO, we used the area under the receiver operating curve (AUROC) and 95% confidence intervals. We identified16,884 prehospital records with one or more documented stroke scales of interest. Of these, 41.8% (n = 7,065) were diagnosed with stroke, of which 74.5% (n = 5,265) were ischemic. Of those with ischemic stroke 25.0% (n = 1,317) were diagnosed with an LVO. A CPSS score of 2 or higher was found to be predictive of LVO, with a sensitivity of 73.4% and specificity of 68.9%. The sensitivity of CSTAT was 60.0% and the specificity was 77.2%. FAST-ED had a 52.2% sensitivity and a 77.4% specificity. BE-FAST's sensitivity was 63.3% and its specificity was 66.9%. For each scale, the AUROC was 0.770 (0.757–0.783), 0.696 (0.521–0.872), 0.725 (0.681–0.770), and 0.685 (0.636–0.734), respectively. There was no statistically significant difference between the four scales for prehospital determination of large vessel occlusion.

28. **Jefferson G. Williams, Remle P. Crowe, Christopher Colangelo, Aaron Wenzel, Andrew W. Godfrey, Michael W. Bachman, Donald Garner, Jose G. Cabanas, J. Brent Myers. Enhancing 9-1-1 Call Prioritization: The Association between Emergency Medical Dispatch, Time-Critical EMS Interventions, and Emergency Department Outcomes. NAEMSP 2024, Austin TX.**

The study objective was to evaluate the association between the International Association of Emergency Dispatch Medical Priority Dispatch System (MPDS) EMD protocol/determinant level combinations and need for immediate EMS response defined by prehospital provision of time-critical interventions and emergency department disposition. We retrospectively analyzed 9-1-1 EMS dispatches from a large county-based EMS service from 6/1/2019–12/31/22. MPDS protocols describe the chief complaint while determinant levels describe acuity from omega (minor) to echo

(immediately life-threatening). Included were MPDS codes from undifferentiated 9-1-1 calls, while non-MPDS EMS dispatches were excluded. Primary outcomes, intended as a proxy for necessary immediate response, included time-critical EMS patient care intervention (e.g., defibrillation) as determined by two board-certified EMS physician medical directors, and hospital admission from ED or death. Descriptive statistics were calculated. A non-parametric test for trend was used to evaluate proportion of calls with time-critical intervention or admission/death, by protocol/determinant. We analyzed 328,006 responses, with 233,158 (71%) transports, of which 195,998 (84%) had ED outcomes. A matrix of 147 protocol/determinant combinations was generated with columns for time-critical EMS intervention and hospital admission/death. Overall, time-critical EMS interventions increased as the determinant levels moved from omega to echo (1.6% to 54.3%, p-trend < 0.001). When limiting to patients who were transported, ED admission/death followed a similar trend from omega to echo (17.1% to 57.6%, p-trend < 0.001). Twenty-nine EMD protocol/determinant combinations (representing 6,663 responses) had proportions of time-critical intervention or admission/death of < 5%. Conversely, 11 EMD protocol/determinant combinations (representing 27,866 responses) had proportions of time-critical intervention or ED admission/death of >50%.

29. **Tanner Smida, Laura Voges, Remle Crowe, James Scheidler, James Bardes. Prehospital Transcutaneous Pacing in the United States: Treatment Epidemiology, Predictors of Treatment Failure, and Associated Outcomes. NAEMSP 2024, Austin TX.**

This research aimed to characterize the outcomes of patients receiving prehospital TCP in the United States. We used the 2018–2021 ESO Data Collaborative public use research datasets for this retrospective study. We included all 9-1-1 encounters with documented TCP attempts. Mortality was derived from hospital discharge disposition data. TCP failure was defined as initiation of CPR following the first TCP attempt among patients who did not undergo CPR prior to the first TCP attempt. Multivariable logistic regression models using age and sex as covariables were used to explore the association between clinical variables, prehospital vital signs, and TCP failure. During the study period, TCP was performed during 13,270 patient encounters and outcome data was available for 2,560 of these patient encounters. The mortality rate following TCP was 63.4% (1,623/2,560) overall, and 33.6% (405/1,205) for patients who did not experience prehospital cardiac arrest. Among patients who did not experience cardiac arrest prior to the first TCP attempt (n = 7,930), progression to cardiac arrest occurred 20.4% of the time. Factors associated with TCP failure included weight (>100 vs. 60–100 kg, aOR: 1.33 [1.15, 1.55]), a pre-pacing non-bradycardic heart rate (>50 vs. < 40 bpm, aOR: 2.87 [2.39, 3.44]), and pre-TCP hypoxia (< 80% vs. >90% SpO2, aOR: 6.01 [4.96, 7.29]).

30. **Henry E. Wang, Mengda Yu, Remle Crowe, Michelle Nassal, Alexander Ulintz, Christopher Gage, Jonathan Powell, J. Madison Hyer, Lai Wei, Travis Sharkey, Ashish Panchal. Longitudinal Trends in Prehospital Advanced Airway Management in the United States. NAEMSP 2024, Austin TX.**

We sought to describe longitudinal trends in EMS advanced airway management in the US. In this retrospective cross-sectional study, we analyzed 2011–2021 data from ESO, a national data set of US prehospital electronic health records. We included all 9-1-1 events with attempted advanced airway management, including ETI and SGA attempts. We determined the annual percentage receiving ETI and/or SGA attempts. We determined temporal trends using generalized linear regression. We stratified the analyses by condition (cardiac arrest, trauma, medical non-arrest) and age (adult vs. children [< 18 years]). Across the 11-year study period, 355,532 patients underwent prehospital advanced airway management (annual incidence 9.0–10.0 per 1,000 9-1-1 events), including cardiac arrest 76.1%, trauma 5.0%, medical non-arrest 18.9%, and pediatrics 6.3%. Patient and event characteristics were: mean age 61 ± 20 years, male sex 61.4%, White race 68.1%, rural setting 18.6%. Annual cases with SGA attempts increased almost three-fold (20.8% to 53.2%, p-trend < 0.001) with corresponding decreases in ETI attempts (90.0% to 60.7%, p-trend < 0.001). Longitudinal trends for cardiac arrest (SGA increased from 25.1% to 60.6%, p-trend < 0.001; ETI decreased from 87.3% to 54.7%, p-trend < 0.001) were similar. Trends in advanced airway

management for trauma (SGA increased from 13.8% to 25.7%, p-trend = 0.003; ETI decreased from 93.7% to 85.2%, p-trend = 0.0005) and medical non-arrest cases (SGA 15.7% to 20.0%, p-trend = 0.26; ETI 93.3% to 87.5%, p-trend = 0.85) were less pronounced. In children annual cases with SGA attempts increased five-fold (11.2% to 50.9%, p-trend< 0.001) with corresponding decreases in ETI attempts (89.7% to 60.6%, p-trend< 0.001).

31. Michael Kaduce, Kathryn Fivelstad, Steven O'Brady, Bill Drees, Erin Vidal, Antonio R. Fernandez, David Wampler. Prehospital Factors that Predict Emergency Department Discharge in Patients Presenting to EMS with Chest Pain. EMS World Expo 2023. New Orleans LA.

This study aimed to describe prehospital factors that predict ED discharge in patients with cardiac chest pain. This retrospective evaluation included all 9-1-1 responses with primary impressions of acute coronary syndrome. Data source: ESO Data Collaborative from 2022. Inclusion criteria: cardiac chest pain and known ED disposition. Exclusion criteria: pediatrics, cardiac arrest, pregnancy, and ED disposition of AMA. The outcome of interest was ED discharge. Variables analyzed were demographics, vital signs, prehospital EKG interpretation, socioeconomic status, and Social Vulnerability Index (SVI) quartiles. Descriptive statistics and univariable odds ratios were calculated. 103,358 patients were included, 46% admitted, 54% discharged. Females had a lower odds of discharge (OR: 0.80, 95%CI: 0.78–0.82). Blacks (OR: 1.38, 95%CI: 1.34–1.42), Hispanics (OR: 1.48, 95%CI: 1.41–1.55), and "other" races (OR: 1.45, 95%CI: 1.23–1.72) had increased odds of discharge than Whites. There was no difference between SVI quartiles. Clinical findings favoring discharge included systolic pressure (SBP) >140 mmHg (OR: 1.13, 95%CI: 1.10–1.16), mean arterial pressure (MAP) >100 mmHg (OR: 1.40, 95% 1.36–1.43), shock index (SI) of 0.5–1.0 (OR: 1.23, 95%CI:1.19–1.26). Clinical findings showing decreased odds of discharge included bradycardia or tachycardia (< 60 or >100) (OR: 0.44, 95%CI: 0.42–0.46), (OR: 0.74, 95%CI: 0.72–0.76), respectively; diastolic hypotension (<50 mmHg) (OR: 0.36, 95%CI: 0.33–0.39), systolic hypotension (<100 mmHg) (OR: 0.42, 95%CI: 0.39–0.44), hypoglycemia (<60 mg/dl) (OR: 0.41, 95%CI: 0.35–0.48), or hyperglycemia (>120 mg/dl) (OR: 0.60, 95%CI: 0.58–0.62), SI greater than 1.0 (OR: 0.63, 95%CI: 0.60–0.65), and MAP hypotension (<60 mmHg) (OR: 0.38, 95%CI: 0.35–0.43). Prehospital ECG interpretation was available on 64,689 patients. All abnormal interpretations had lower odds of discharge; ST changes (OR: 0.17, 95%CI: 0.11–0.25), STEMI/intervention (OR: 0.32, 95%CI: 0.30-0.34), and nonspecific (OR: 0.42, 95%CI: 0.41–0.44).

32. Mario A. Camacho, Esmeralda Melgoza, Holden M. Wagstaff, Richard Huff, Edder J. Peralta, Jaime Kennel. Prehospital Cerebrovascular Accident Diagnostic Inaccuracy in Patients with Limited English Proficiency. EMS World Expo 2023. New Orleans LA.

This study examines if LEP affects the diagnostic accuracy of cerebrovascular accidents (CVA) by EMS clinicians in the prehospital setting. Using descriptive and multivariate logistic regression models, a retrospective analysis was conducted on 20,138 cases from the 2022 national ESO dataset. Diagnostic accuracy was determined by comparing EMS clinician impressions with CVAs diagnosed in the emergency department (ED). LEP was identified when listed as a barrier to care by EMS. The analytic sample was limited to ALS/BLS 9-1-1 transports of patients 18 and older with recorded ED diagnoses of CVA as determined by ICD-10 codes. Patients with LEP who were having CVAs were 19% less likely (aOR = 0.81, 95% CI: [0.67–0.98]) to be correctly identified by EMS clinicians compared to patients without LEP when adjusting for patient age, race, and gender.

33. Aaron Peth, Dominic J. Gregorio, Scott A. Studebaker, Alexander D. Muniz, Cole G. Camacho, Bilie Williams, Douglas F. Kupas, and Lawrence H. Brown Safety and Timeliness of Emergency Medical Service Administration of Antibiotics for Traumatic Injuries. EMS World Expo 2023. New Orleans LA.

The study objective was to describe current prehospital use of antibiotics for traumatic injury, and to estimate the potential time savings associated with antibiotic administration by emergency medical service (EMS) clinicians. A retrospective analysis was conducted based on the 2022 ESO Data

Collaborative research dataset. Subjects were patients who had suffered injuries that resulted in 9-1-1 scene responses and who had received antibiotics from EMS. Time to antibiotic administration was calculated as the elapsed time from EMS dispatch until antibiotic administration and the elapsed time from EMS arrival on scene until antibiotic administration. The minimum potential time saved by EMS antibiotic administration was calculated as the elapsed time from administration until emergency department arrival. To assess safety, epinephrine administration was used as a proxy for the adverse event of anaphylaxis. A total of 1155 injured patients met the inclusion criteria and received EMS-administered antibiotics. The median and interquartile range of elapsed time from EMS dispatch until antibiotic administration was 31 (24–32) min; the elapsed time from arrival on scene until antibiotic administration was 21 (16–30) min. The median potential time savings associated with prehospital antibiotic administration was 16 (9–27) min. Notably, 348 patients (30%) had total prehospital times exceeding 1 h. None of the patients who received antibiotics also received epinephrine for presumed anaphylaxis.

34. **Michael W. Hubble, Stephen Taylor, Sara E. Houston, Melisa Martin, and Ginny K. Renkiewicz. Delayed Call Receipt-to-Epinephrine Administration Prolongs Epinephrine-to-ROSC Interval in Out-of-Hospital Cardiac Arrest. EMS World Expo 2023. New Orleans LA.**

The objective of this study was to quantify the relationship between the CtE and EtR intervals. We conducted a retrospective analysis using the 2020 ESO Data Collaborative dataset containing calls from January 2020 through December 2020. Adults with nontraumatic, witnessed arrests were included. End-of-event was defined as ROSC, termination of resuscitation, or hospital arrival without ROSC. A Cox proportional hazard model was used to determine the influence of CtE on EtR after controlling for potential confounders. Of the 6725 patients analyzed, 1897 (28.2%) presented with a shockable rhythm, 2051 (30.5%) received bystander CPR, and 3201(47.6%) attained ROSC. The mean CtE and EtR were 16.1 (±4.9) min and 14.02 (±10.3) min, respectively. After controlling for patient age, sex, minority status, arrest etiology, shockable rhythm, bystander CPR, advanced airway, and automated external defibrillator use, CtE was associated with decreased likelihood of ROSC (heart rate [HR] = 0.97 per minute, $p < .001$) when measured as a continuous variable. When stratified by 10-min increments with 0–10 min as reference, CtE was negatively associated with ROSC (HR = 0.86, $p < .001$) and (HR = 0.68, $p < .001$) for the 11–20 and 21–30 min categories, respectively.

35. **Melisa Martin, Michael W. Hubble, Sara E. Houston, Stephen Taylor, and Ginny K. Renkiewicz. Probability of a Shockable Presenting Rhythm Based on Initial CPR Provider. EMS World Expo 2023. New Orleans LA.**

This study aimed to evaluate the effect of the first provider of CPR on the likelihood of a shockable presenting rhythm. This retrospective study used national data collected between January 2020 and December 2020 from the ESO Data Collaborative. Patients included were adults who suffered nontraumatic, witnessed arrests prior to EMS arrival. Logistic regression was used to calculate the odds ratio (OR) for shockable presenting rhythm by when CPR was initiated (prior to first responder arrival, upon first responder arrival, or upon EMS arrival). A total of 13,645 patients were included, of whom 70% received CPR prior to EMS arrival and 27% had shockable presenting rhythms. The sample was largely White (74%) and male (62%) with a cardiac etiology of arrest (82%). After controlling for age, sex, minority status, arrest etiology, and EMS response interval, patients were less likely to present with shockable rhythms if CPR was first initiated after arrival of first responders (OR = 0.84, $p < .001$) or EMS personnel (OR = 0.78, $p < .001$) compared to bystanders. This outcome was more pronounced with EMS response intervals of less than 5 min.

36. **Michael W. Hubble, Ginny K. Renkiewicz, and Melisa D. Martin. Influence of Patient Body Weight on Probability of Return of Spontaneous Circulation following Out-of-Hospital Cardiac Arrest: An Exploratory Analysis. EMS World Expo 2023. New Orleans LA.**

This study aimed to assess the relationship between patient body weight and return of spontaneous circulation (ROSC) during OHCA. This retrospective study included adult patients from a national emergency medical service (EMS) electronic health record who experienced witnessed, nontraumatic OHCA prior to EMS arrival from January 2020 through December 2020. Logistic regression was used to evaluate the relationship between patient weight and ROSC while controlling for potential confounders. A total of 9096 patients met inclusion criteria and had complete data for analysis. Males accounted for 64.3% of the sample, and 25.3% were minorities. The mean age of the participants was 65.0 (±15.8 SD) years with a mean weight of 93.5 kg (±31.5 SD). Altogether, 81.8% of arrests were of presumed cardiac etiology, and 30.3% presented with shockable rhythms. Layperson CPR and automated external defibrillator defibrillation were performed prior to EMS arrival in 30.6% and 7.3% of cases, respectively, and 44.0% experienced ROSC. ROSC was less likely with patient weight >100 kg (odds ratio [OR] = 0.71, $p < .001$), male sex (OR = 0.78, $p < .001$), and increasing age and EMS response interval (OR = 0.99 per year, $p < .001$ and OR = 0.97 per minute, $p < .001$, respectively). Patients presenting with shockable rhythms were more likely to achieve ROSC (OR = 1.79, $p < .001$) as were patients receiving layperson CPR (OR = 1.17, $p < .001$) and defibrillation prior to EMS arrival (OR = 1.66, $p < .001$). Advanced airway placement and nonwhite race were not predictors of field ROSC. Although the mean first epinephrine dose (mg/kg) followed a negative curvilinear trend due to its non-weight-based dosing scheme, the mean total epinephrine dose administered to achieve ROSC demonstrated an upward linear trend of 0.05 mg for every 5 kg of body weight.

37. **Michael W. Hubble, Ginny K. Renkiewicz, and Melisa D. Martin. Optimal Weight-Based Epinephrine Dosing for Patients with Low Likelihood of Survival following Out-of-Hospital Cardiac Arrest. EMS World Expo 2023. New Orleans LA.**

This research sought to identify an optimal weight-based epinephrine dose for attaining return of spontaneous circulation (ROSC) among patients most likely to benefit from epinephrine during OHCA. This retrospective study included adult patients from a national emergency medical service (EMS) electronic health record vendor who experienced witnessed, nontraumatic OHCA prior to EMS arrival from January 2020 through December 2020. To focus on patients for whom epinephrine offers the greatest potential benefit, we excluded patients with shockable presenting rhythms and bystander cardiopulmonary resuscitation. The area under the receiver operator characteristic curve (AUROC) was used to assess the predictive value of epinephrine dose (mg/kg) for ROSC following a single bolus. From the ROC curve values, the optimal threshold dosage for ROSC was determined based on the concordance probability method. A total of 2463 patients met inclusion criteria and had complete data for analysis. Males accounted for 61.3% of the sample, and 29.5% were minorities. The mean age of participants was 66.7 (±15.9 SD) years with a mean weight of 91.2 kg (±31.5 SD). Arrest etiologies included cardiac (80.6%), respiratory/asphyxia (13.2%), overdose (2.7%), and other (3.5%). A total of 190 patients (7.7%) attained ROSC after the first epinephrine administration. The mean dose (mg/kg) was higher in the group attaining ROSC (0.014 vs. 0.012, $p < .001$). The dosage AUROC for ROSC was 0.61 ($p < .01$). As calculated by the concordance probability method, the optimal threshold first epinephrine dosage was 0.013 mg/kg.

38. **William P. Cebulskie, Remle P. Crowe, Danielle DiCesare, Jeffery Rollman, Lynne Singelton, Casey Smith, Lynn White. EMS Transport of Pediatric Patients Meeting Termination of Resuscitation Criteria. EMS World Expo 2023. New Orleans LA.**

The aim of this research was to evaluate the rate of EMS transportation of pediatric patients in cardiac arrest who met pediatric termination of resuscitation (pTOR) criteria. For this retrospective analysis, we used the 2022 ESO Data Collaborative to identify 9-1-1 EMS responses for patients ages 0–17 years with cardiac arrest and attempted resuscitation by EMS. We excluded EMS-witnessed arrests and drownings. We applied the Maryland pTOR criteria for medical and traumatic arrests and summarized categorical variables using frequencies and percentages. We analyzed 1,278 pediatric cardiac arrests. Overall, 87% (n = 1,110) were

transported, of which 27% (n = 299/1,110) had documented ROSC during the EMS encounter. Most arrests were medical (87%, n = 1,117) and 13% were traumatic (n = 161). pTOR criteria were met for 9% (n = 106/1,117) of medical arrests and 37% (n = 59/161) traumatic arrests. Of those meeting pTOR criteria, 34% (n = 36/106) of medical arrests and 73% (n = 43/59) of traumatic arrests were transported. In patients transported without ROSC during the EMS encounter (n = 811), 9% (n = 64/708) of medical arrests met the 30-minute minimum scene interval and 58% of trauma arrests (n = 60/103) met the 10-minute minimum scene interval for termination eligibility. One-in-three patients meeting medical pTOR criteria and nearly three-out-of-four patients meeting traumatic pTOR criteria were transported by EMS. In medical arrests, most patients without ROSC were transported prior to meeting scene time for pTOR eligibility, suggestive of a “scoop and run” approach that may limit high-quality resuscitation.

39. **Andrew G. Tischer, Jackson Baker, Trenton Husick, Kevin P. McCarthy, Kayla Riel, David Wampler. Rural versus Urban Settings in Treatment Initiation of Cardiac Arrest (RUSTIC): Factors Influencing the Initiation of Cardiac Arrest Resuscitation in Rural versus Urban Settings. EMS World Expo 2023. New Orleans LA.**
The objective of this study was to describe differences in initiation of resuscitative treatment in witnessed cardiac arrest between rural and urban settings. A retrospective analysis was conducted on all 9-1- 1 responses for adult patients with bystander-witnessed OHCA of presumed cardiac etiology. Exclusion criteria: Unwitnessed arrest, do not resuscitate (DNR or POLST), or etiology other than presumed cardiac. The data source: the national ESO Data Collaborative (Austin, TX) from 2022. Variables considered were unit level of care, demographic information, response intervals, and location type across urban, rural, and super-rural areas. Descriptive statistics, logistic regression, adjusted odds ratios (aOR), and 95% confidence intervals (95%CI) were calculated. When compared to urban settings, rural patients had decreased odds of having CPR initiated [aOR 0.70 95%CI: 0.56–0.88], super-rural [aOR 0.47 95%CI: 0.32–0.68]. Adjustment accounted for unit level of care, demographics, response intervals, and location type. Bystander CPR was the stronger predictor of EMS initiation of resuscitation [aOR 8.21 95%CI: 6.10–11.07]. Other predictors were male sex [aOR 1.51 95%CI: 1.25–1.83], and African American [aOR 1.42 95%CI: 1.06–1.90] compared to White/non-Hispanic/Latino. Patients over 85 years had decreased odds even if the OHCA was witnessed [aOR 0.27 95%CI: 0.17–0.43]. Conclusion: Rural and

40. **Maria Beermann-Foat, Jamie Kennel, Charles Foat, Jewel W. Williams, Jason W. Derrey, Whitney Burr, David I. Page. Racial and Gender Disparities in EMS Naloxone Treatment for Opioid Overdoses. EMS World Expo 2023. New Orleans LA.**
The objective of this study is to investigate racial and ethnic treatment inequities in naloxone administration in the setting of suspected opioid overdose. A retrospective analysis was performed on EMS encounters from 2021 in the ESO Data Collaborative. Cases included patients aged 18 years or older during a 9-1-1 ALS response where the clinician entered a primary or secondary impression of opioid overdose. Descriptive and multivariable regression analysis was used to examine the role patient race and gender have on the administration of naloxone during an opioid overdose. All racial and ethnic minority patients studied, and female patients were less likely to receive naloxone compared to White and male patients. Specifically, Black patients were 21% less likely (95%CI: 17%-25%, $p < 0.001$), Asian patients were 62% less likely (95%CI: 49%-71%, $p < 0.001$], and Hispanic patients were 12% less likely (95%CI: 6%–17%, $p < 0.001$) when compared to White patients to receive naloxone. Further, female patients were 13% less likely (95%CI: 4%-23%, $p < 0.01$) to receive naloxone when compared to their male counterpart.

41. **Faith Applewhite, Dan D. Cohen, Remle P. Crowe, Benjamin B. Currie, Terri L. King, Christopher J. Lance, Michael Lozano, Juan Mejias, Alison Treichel, Joseph Zalkin, Scott S. Bourn.**

Characteristics and Outcomes of Prehospital Encounters for Patients with Behavioral Emergencies Receiving Physical Restraints and/ or Sedation. EMS World Expo 2023. New Orleans LA.

The objective of this research was to describe outcomes for patients with behavioral health emergencies (BHE) who received prehospital restraint and/or sedation. Using the 2021 ESO Research Collaborative database, we conducted a retrospective analysis of adults (<18 years) with BHE encountered by advanced life support EMS units on 9-1-1 calls. We calculated the proportions of patients who received physical restraint and/or emergent intramuscular sedation (ketamine, benzodiazepine, or antipsychotics). Our primary outcomes were emergency department disposition, length of stay (LOS), and diagnoses. We calculated frequencies/percentages and medians with interquartile ranges (IQR). Among those receiving restraint/sedation, median age was 34 (IQR: 26– 46) years and 40% (n= 11,173) were female. Over half were White (55%, n= 14,820), 27% (n= 7,117) were Black, and 16% (n= 4,237) were Hispanic. Most (97%, n= 27,556) were transported. Linked ED data were available for 36% (n¼ 9,785). Of those with ED disposition, 63% (n¼ 6,160) were discharged from the ED with a median LOS of 7.7 h (IQR:4.5 to 12.9), 20% were admitted, 11% were transferred to other facilities, and 0.02% (n= 6) patients died in the ED. The top three ED diagnosis categories for those discharged were: alcohol related disorders (F10: 17%, n= 947), signs/symptoms involving an emotional state (R45: 10%, n= 552), and other stimulant related disorders (F15: 9%, n=506).

42. **Treichel, A., Crowe, R., Fernandez, A., Bourn, S., Myers, B. Trends in EMS Encounters for Children and Teenagers with Firearm Injuries from 2018 to 2022. EMS World Expo 2023. New Orleans LA.**

The study objective was to describe changes in patient and encounter characteristics among EMS encounters for children with firearm injuries prior to and during the COVID-19 pandemic. We used data from the 2018-2022 ESO Data Collaborative for this retrospective analysis. We only included EMS agencies that were part of the Collaborative throughout the five-year study period. All 9-1-1 records for patients ages 0-19 years with documented injuries from firearms were included. We calculated annual percent changes stratified by patient age, gender, race/ethnicity, socioeconomic status and EMS encounter characteristics. Among 7,913 total encounters, median age ranged from 16-17 years; most encounters were among male patients (80%-83%). Between 9%-10% of children with firearm injuries died on scene each year. Among transported patients with hospital outcome data (n=2,049), 7% died. Firearm injuries increased 79% over the study period, peaking in 2021 (n=2,036). In all study years, assault (96% total percent increase) was the most documented injury intent category, followed by unknown (137% total percent change), accidental (9% total percent change) and self-harm (37% total percent change).Black children represented between 61%- 69% of total encounters annually. Moreover, Black and Hispanic children experienced the largest total percent increase in firearm injuries between 2018 to 2022 (86%; 110%). Over half of encounters occurred in communities of greatest socioeconomic vulnerability, ranging between 59%-54% annually.

43. Christopher Villani, **Josh Kimbrell, Kyle Rice - Adam Wagner, Amelia Breyre, Alison Treichel, Scott Bourn. Impact of Obesity on Prehospital Analgesia Administration for Patients with Long Bone Fractures. EMS World Expo 2023. New Orleans LA.**

Our objective is to investigate the impact of obesity on prehospital analgesia administration for patients with long bone fractures at the intersection of race/ethnicity, gender, and socioeconomic status. Using the 2022 ESO Data Collaborative, we retrospectively analyzed Emergency Medical Services (EMS) records for 9-1-1 advanced life support transport of adult patients diagnosed with long bone fractures at the emergency department. Weight status was defined using the Center for Disease Control (CDC) Body Mass Index thresholds. Body Mass Index was inferred from provider-documented patient weight, race/ethnicity, and gender using

CDC height averages. We compared rates of prehospital analgesic administration by weight status, accounting for race/ethnicity, gender, age, fracture location, scene/transport time, pain severity, and scene Social Vulnerability Index (SVI).
Among the 21,289 patients that were identified with long-bone fractures by 513 EMS agencies, 6,917 were classified as obese (32.5%). Patients with obesity received nearly equal rates of analgesia administration as those without obesity in cases where the patient reported a pain score of six or higher (77.4% [95% CI: 75.9-78.7%] vs. 76.9% [75.8-77.9%]). Furthermore, the rates of documented pain screenings (84.4% [83.5-85.3%] vs. 83.0% [82.1-83.4%]), of severe pain (59.6% [58.3-60.8%] vs. 52.3% [51.4-53.2%]), and of pain reduction by two or more points from first to last pain score (70.9% [69.1-72.6%] vs. 73.1% [71.8-74.3%]) showed no significant changes by weight status. These results remained consistent after adjusting for race/ethnicity, gender, age, and scene SVI.

44. **Daniel P. Burke, Remle P. Crowe, Alison Treichel, J. Brent Myers, Scott S. Bourn, Antonio R. Fernandez. Evaluation of EMS Transport for Out-of-Hospital Falls among Older Adults in Washington, DC. NASEMSO 2023.**
The objective of this study was To describe characteristics associated with transport among aging patients cared for by EMS for an out-of-hospital fall in Washington, DC. In this retrospective analysis we analyzed all prehospital care records submitted to the Washington, DC Department of Health from January 1, 2022 to December 31, 2022. Records were included in the analysis if the requested service was a 9-1-1 response, the provider impression ICD 10 code or primary injury ICD 10 code was consistent with a fall, and the patient's age was 60 years or older (consistent with the consensus statement by the Geriatric Emergency Care Applied Research Network). A multivariable logistic regression model was fit to evaluate the adjusted odds of EMS transport. In 2022, there were 261,996 9-1-1 responses in Washington, DC. Of those, 2% (4,892) of patients were encounters among older adults for an out-of-hospital fall. Overall, 58% (2,819) were female. The median age was 74 (interquartile range: 66-83). Those with their race/ethnicity documented as Black or African American, not Hispanic or Latino (55%, n=2,700) made up the highest percentage of patients, followed by White, not Hispanic or Latino (37%, n=1,799), Hispanic or Latino (5%, n=185), and all other race/ethnicities (4%, n=184). Most incidents took place in a home or residence (51%, N=2,516), followed by outdoor/pubic locations (40%, n=1,945), and communal living facilities (9%, 426). Alcohol or drug indicators were documented on <1% (36) of these 9-1-1 responses. BGL was documented on 53% (2,606) of patient records. About half of these incidents (51%, n=3,470) occurred in communities with poverty levels of 15% or less. Overall, 12% (576) of patients seen for an out-of-hospital fall were not transported by EMS. The multivariable regression model revealed no statistically significant difference in the odds of EMS transport for patients who suffered an out-of-hospital fall with respect to patient gender, age, race/ethnicity or percent poverty.

45. **Christopher T.E. Price, Christine K. Greff, Remle P. Crowe, Alison Treichel, J. Brent Myers, Scott S. Bourn, Jennifer K. Wilson, Antonio R. Fernandez. Rural Disparities in EMS Stroke Care Performance Measures in North Dakota. NASEMSO 2023.**
The study objective was to compare EMS performance for encounters in rural and urban communities in ND on stroke-related Rural EMS Counts Measures. Secondarily, for encounters with a positive stroke screen, we evaluated whether the receiving facility was alerted. This retrospective analysis evaluated all 9-1-1 responses for patients with suspected stroke from January 1, 2020 to December 31, 2022. Suspicion of stroke was identified using the NEMSIS elements "Provider's Primary Impression" (eSituation.11) and "Provider's Secondary Impression" (eSituation.12) using ICD10 codes I60, I61, I62, I63, and G45. Stroke-related Rural EMS Counts measures included: blood glucose (BGL) check performed for suspected stroke, last known well or onset time (LKW) recorded for suspected stroke, and stroke assessment performed for suspected stroke. Further, we determined if the EMS clinician documented a stroke

alert/notification for the destination facility when a stroke screen was positive. Comparisons were evaluated based on Centers for Medicare and Medicaid urbanicity (rural/urban). Descriptive statistics and univariate odds ratios were calculated. During the study period, there were 153,900 9-1-1 responses in ND. Of those, 1.5% (2,399) met the study criteria for EMS-suspected stroke. Overall, 50% (1,193) of patients were female. The median age was 73 years (interquartile range: 62 to 83 years). Race/ethnicity was not documented for 29% (687) of patients. Among those with documented race/ethnicity, most were documented as White, non-Hispanic (89%, n=1,531), followed by American Indian or Alaska Native (7%, 119). Among all 9-1-1 responses for suspected stroke, 60% (1,443) were in rural areas. In rural areas 73% (1,005) of encounters had a documented BGL compared to 79% (758) in urban areas (p=0.001). There was a 29% decrease in odds of having a BGL documented in rural areas compared to urban areas (OR: 0.71, 95%CI: 0.58-0.86). In rural areas 60% (862) had onset/LKW documented compared to 80% (760) in urban areas (p<0.001). There was a 62% decrease in the odds of having a LKW documented in rural areas compared to urban areas (OR: 0.38, 95%CI: 0.32-0.46) A stroke screen was documented for 60% (855) of patients with suspected stroke in rural areas compared to 97% (924) of patients in urban areas (p<0.001). Patients with suspected stroke in rural areas had 95% reduced odds of a documented stroke assessment compared to patients in urban areas OR: 0.05, 95%CI: 0.04-0.07). Among the 1,348 patients with a positive stroke screen, 62% (398) of patients encountered in rural areas had a documented stroke alert compared to 33% (235) in urban areas (p<0.001). When compared to urban areas, the odds of documenting a stroke alert among those with a positive stroke screen were increased 3-fold in rural areas (OR: 3.36, 95%CI: 2.69-4.20).

46. **Jessica Rosner, Daisy Banta, Adam L. Harrell, Remle P. Crowe, J. Brent Myers, Alison Treichel, Scott S. Bourn, Antonio R. Fernandez. A Statewide Evaluation of Validated EMS Patient Safety Clinical Trigger Tool Criteria in the Commonwealth of Virginia. NASEMSO 2023.**
The objective of this study was to quantify the frequency with which 9-1-1 encounters met select EMS clinical safety trigger criteria within the Commonwealth of Virginia during 2022. This retrospective study evaluated all EMS events submitted between January 1, 2022 and December 31, 2022 to the Virginia Pre-Hospital Information Bridge, provided by ESO (Austin, TX). Inclusion criteria were: 1) 9-1-1 response, 2) successful passage of state data validation (in the NEMSIS 3.4 standard), and 3) a disposition consistent with patient treatment and transport. EMS clinical triggers evaluated included: SpO2 < 94% without supplemental oxygen provided or < 85% without assisted ventilation administered; change in systolic blood pressure (SBP) > 20% from first measurement; pain score > 4/10 without subsequent reduction; temperature > 38o C without subsequent reduction; and administration of an opioid analgesic and naloxone in the same patient. Safety trigger frequency was compared based on the level of care of the responding EMS unit (ALS or BLS). The most frequently documented triggers were also compared among events in urban and rural areas based on the Centers for Medicare and Medicaid classifications. Descriptive statistics, univariate odds ratios (OR), and 95% confidence intervals (95%CI) were calculated. A total of 735,053 responses met inclusion criteria. Of those, 18% (129,218) occurred in rural areas and 82% (605,565) in urban areas. Overall, BLS units responded to 19% (140,592) of calls and ALS units responded to 81% (594,461). Overall, at least one trigger tool criterion was met among 34% (249,816) of records. The order of the most common triggers did not differ by level of care (i.e., ALS vs. BLS) of the responding unit. EMS encounters in rural areas had 18% greater odds of meeting at least one patient safety trigger criterion compared to urban areas (OR: 1.18, 95% CI: 1.17-1.20).

47. **Tom Mitchell, James E. Winslow, James A. Hood, Chuck Lewis, Remle P. Crowe, J. Brent Myers, Alison Treichel, Scott S. Bourn, Antonio R. Fernandez. The EMS Workforce Reducing Effects of the COVID-19 Pandemic in North Carolina. NASEMSO 2023.**
The objective of this study was to compare the proportion of credentialed EMS professionals in NC who provided traditional EMS patient care in 2019 and 2021. This retrospective observational study examined all credentialed EMS professionals in NC in 2019 and 2021. Study

data were obtained from the NC EMS Data Repository provided by ESO (Austin, TX). EMS professionals providing patient care were identified as those whose names appeared on one or more electronic health records (EHRs) during the study period. EMS certification level and number of responses were also evaluated. Comparisons were made before and after the COVID-19 pandemic (January 1, 2019 to December 31, 2019 vs. January 1, 2021-December 31, 2021). Descriptive statistics and percent change were calculated. In 2019, there were 1,907,164 EMS activations (911 responses: 77%, n=1,459,443) compared to 2,091,249 EMS activations (911 responses: 79%, n=1,647,472) in 2021, representing a 10% increase in total activations. Meanwhile, the number of actively credentialed EMS professionals dropped by 7% from 45,726 in 2019 to 42,467 in 2021. The proportion of EMS professionals credentialed at each level was similar between 2019 and 2021 (EMT-Basic: 66% [n=30,390] vs 66% [n=27,885], Paramedic: 25% [n=11,209] vs 25% [n=10,751], EMT-Intermediate: 5% [n=2,243] vs 4% [n=2,135], Medical Responder 4% [n=1,884] vs 4% [n=1,696], respectively). Among actively credentialed EMS professionals, 26% were listed on an EHR at least once in 2019 compared to 27% in 2021. While the percentage increased, the total number of EMS professionals that were listed on an EHR decreased by 3% when comparing 2019 (n=11,905) to 2021 (n=11,559).

48. **Susan J. Burnett, Rachel Stemerman, Johanna C. Innes, Maria C. Kaisler, Remle P. Crowe, Brian M. Clemency. EMS Documentation of Social Determinants of Health: A Mixed-Methods Study Using Natural Language Processing and Grounded Theory. NAEMSP 2023. Tampa, Florida.**
The purpose of this study was to understand how EMS professionals document SDOH through a qualitative analysis of EMS records identified by a machine learning tool. We retrospectively evaluated all 9-1-1 records for adult patients (18 years) in the 2019 ESO Data Collaborative research dataset. We applied a published natural language processing (NLP) corpus to identify narratives with documentation of at least one social determinant from six predetermined categories (food, housing, insurance, employment, financial, and social support). From those results, 100 records per determinant category were randomly selected for further manual analysis using an interpretive paradigm and grounded theory approach. By applying the hermeneutical method, we described the documentation of social determinants in EMS records. EMS professionals do not regularly explicitly document SDOH in patient care records. Out of the 5,665,229 records analyzed, 175,378(3.1%) records were identified by the NLP tool as referencing at least one social determinant. All determinant categories included concerns about patients' access, or lack thereof, to services or goods because of inability to afford or otherwise connect with them.

49. **Louis B. Fornage, Christine O'Neil, Stephen R. Dowker, Eric R. Wanta, Ryan S. Lewis, Lawrence H. Brown. Prehospital Intervention Improves Outcomes for Patients in Atrial Fibrillation with Rapid Ventricular Response. NAEMSP 2023. Tampa, Florida.**
The purpose of this study was to compare outcomes of such patients presenting to EMS based on the prehospital treatment they received. This retrospective cohort study used the 2021 ESO Research Collaborative (Austin, TX) dataset. We identified 9-1-1 scene responses for patients aged 16 to 100 years old with initial EKG interpretations as atrial fibrillation and initial heart rates >110/min. Prehospital interventions included vagal maneuvers, medications, and electrical cardioversion. The primary outcome measure was frequency of emergency department (ED) discharge to home; secondary outcomes included hospital length-of-stay (LOS) for admitted patients, and in-hospital mortality. We used propensity score matching to compare results among patients with similar demographics, clinical characteristics, and comorbidities. We reported the adjusted difference in outcomes, number needed to treat (NNT), and 95% confidence intervals (CI). Among propensity-matched patients with atrial fibrillation with rapid ventricular response, initiation of treatment by prehospital clinicians was associated with an increased likelihood of ED discharge, a shorter hospital admission, and reduced mortality. There were 10,234 eligible patients with hospital outcome data. After propensity matching, 8,832 patients were retained in

the analysis: 1,376 (15.6%) with prehospital intervention and 7,456 (84.4%) without intervention. ED discharge to home occurred for 37.4% of the intervention patients and 28.9% of the nonintervention patients (adjusted difference þ7.6%, CI 3.6%–11.6%; NNT 14, CI 9–28). Among admitted patients, median (IQR) LOS was 4 (2.3–7.2) days for intervention patients versus 4.8 (2.9–7.9) days for nonintervention patients. Mortality was 3.9% for intervention patients and 7.2% for nonintervention patients.

50. **Tanner Smida, James J. Menegazzi, Remle P. Crowe, James Bardes, David D. Salcido. Association of Prehospital Post-Resuscitation Hypotension and Hypoxia with Mortality following Out-of-Hospital Cardiac Arrest. NAEMSP 2023. Tampa, Florida.**
The aim of this study was to examine the association between mortality and prehospital post-return of spontaneous circulation (ROSC) hypoxia and hypotension when each vital sign abnormality occurred in isolation and when the abnormalities occurred together. We used the 2018–2021 ESO Data Collaborative public use research data sets for this study. All adult nontraumatic OHCA patients who achieved ROSC and had >1 SpO2 and >1 systolic blood pressure (SBP) recorded post ROSC were screened for inclusion. We derived mortality from linked hospital outcome data. We classified a patient as experiencing hypotension if the lowest recorded post ROSC SBP was less than 90 mmHg, and as experiencing hypoxia if the lowest recorded post-ROSC SpO2 value was less than 90%. We explored the association of these measures with mortality using multivariable logistic regression adjusted for known prognostic factors according to the Utstein template (age, sex, witnessed status, bystander CPR, initial rhythm, public location, and response interval). Post-ROSC hypotension and hypoxia were significantly associated with greater mortality both in isolation and when combined. 17,943 OHCA patients met inclusion criteria, of whom 3,979 had linked hospital outcome data. Approximately one-third (33.8%) of all patients experienced neither hypoxia nor hypotension, 28.8% experienced only hypoxia, 12.7% experienced only hypotension, and 24.8% experienced both hypoxia and hypotension post-ROSC. In comparison to patients who experienced neither hypotension nor hypoxia, patients who experienced only hypoxia had a 64% increase in their odds of mortality (aOR: 1.64 [1.32, 2.05]), patients who experienced only hypotension had a greater than three-fold increase in their odds of mortality (aOR: 3.44 [2.50, 4.75]), and patients who experienced both hypoxia and hypotension had a nearly six-fold increase in their odds of mortality (aOR: 5.87 [4.36, 7.90]).
51. **Alyssa Morgan Green, Adiel Garcia Cuellar, Paul Gallo, Caroline Schwester, David Wampler, Remle Crowe, Brent Myers, Jeffrey L. Jarvis. The Association between Negative Prehospital Spinal Motion Restriction Screening and Spinal Cord Injury. NAEMSP 2023. Tampa, Florida.**
The study objective was to examine the association between negative prehospital NEXUS criteria and SCI requiring hospital admission. This retrospective analysis used the 2021 ESO Data Collaborative dataset to analyze linked prehospital and hospital records for trauma patients from 9-1-1 activations. Patients admitted with SCI were identified using ICD10 diagnosis codes. An age-adjusted logistic regression model was used to analyze the relationship between SCI and NEXUS criteria, overall and by components. Although a negative prehospital SMR screen using NEXUS criteria was associated with reduced odds of SCI, there was a 14% false negative rate. We analyzed 288,309 EMS encounters for trauma patients with hospital outcomes. SCI occurred in 197 (<0.01%) patients, with 164 resulting hospital admission. Among admitted patients with SCI, 64 (39%) had documented prehospital NEXUS SMR screens. Of these, 9 (14%) had negative prehospital SMR screens. After adjustment for age, a negative SMR screen was associated with lower odds of SCI, aOR 0.14 (0.06–0.27), however the sensitivity of a negative SMR screen was only 86% (75–93%).
52. **Louis B. Fornage, Kevin Collopy, Remle P. Crowe, Stephen Taylor. Critical Abnormal Vital Signs following Prehospital Ketamine Administration. NAEMSP 2023. Tampa, FL.**
The study objective was to describe critical abnormal vital signs before and after prehospital ketamine use. In this retrospective cohort analysis, we queried patient encounters for calendar year 2020 from the ESO Data Collaborative. Patients >12 years of age, not pregnant, who

received ketamine by paramedic-staffed ambulances during 9- 1-1 encounters were included. Critical abnormal vital signs were defined as hypotension (systolic blood pressure [SBP]< 90 mmHg), hypoxia (SpO2<75%), or hypercapnia (EtCO2>60mmHg). Descriptive statistics were calculated. While obtaining vital signs prior to prehospital ketamine administration is not always feasible, approximately 1-in-10 patients with pre-ketamine vital signs showed hypotension, hypoxia, or hypercarbia, suggesting potential for preexisting complications unrelated to ketamine administration. Ketamine was administered to 18,664 patients included in the analysis. Average age was 46 years and 58% percent were male. The racial/ethnic distribution was 74% White, 17% Black/African American, 8% Latino, and 1% Asian. Prior to ketamine administration, SBP was documented for 68.0% (12,756), SpO2 for 64.9% (12,167), and EtCO2 for 25.6% (4,793) of patients. Post ketamine administration, SBP was documented for 89.8% (16,848), SpO2 for 89.0% (16,692), and EtCO2 for 63.9% (11,996). After excluding those with documented hypotension prior to ketamine (n ¼ 1,405), 8.0% (1,245/15,552) had post-ketamine hypotension and 3.3% (514/15,552) had hypotension on final assessments. After excluding those with pre-ketamine hypoxia (1,355), 4.6% (719/15,432) had post-ketamine hypoxia and 1.3% (194/15,432) had hypoxia on final assessment. After excluding those with pre-ketamine hypercarbia (493), 7.1% (821/11,530) had post-ketamine hypercarbia and 3.2% (369/ 11,530) had hypercarbia on final assessment.

53. **Mark E. Escott, Remle P. Crowe, Lawrence H. Brown. Factors Associated with Survival to Hospital Discharge in Traumatic Cardiac Arrest. NAEMSP 2023. Tampa, FL.**
The purpose of this study was to describe encounter characteristics associated with survival to hospital discharge in a contemporary, geographically diverse sample of TCA patients receiving prehospital resuscitation and transport to hospital. We queried all 9-1-1 encounters for TCA in the ESO Data Collaborative from 2018 to 2021. Our analysis considered patient demographic (age, sex, race) and encounter (mechanism, initial rhythm, level of care (ALS vs BLS), urbanicity) characteristics. We used multivariable logistic regression to compare demographic and encounter characteristics for survivors and non-survivors among patients with linked hospital disposition data available. Survival to hospital disposition in this national cohort of TCA patients undergoing prehospital resuscitation and transport to hospital was 6.3%. Out of 23,540 TCAs, there were 12,123 encounters with resuscitation attempted and transport to a hospital; 80% were in urban areas and 20% in rural areas. Hospital disposition data were available for 2,035 (16.8%). Overall survival at hospital disposition was 6.3% (CI: 5.3%–7.5%). In multivariable regression, patients in PEA (OR: 1.9, CI: 1.1–3.4) or VF/VT (OR: 5.7, CI: 2.8–11.5) were more likely to survive than those in asystole; patients with blunt trauma (OR: 2.8, CI: 1.5–5.2) were more likely to survive than those with penetrating trauma.

54. **Ignacio A. Rodriguez, Samuel Schow, Sydney E. Jarvis, Brett Meyer, John Gonzales, Nathaniel Thomas, Erin Vidal, Remle P. Crowe. Association between EMS Agency Toolbox and Pain Management Practices by Race/Ethnicity. NAEMSP 2023. Tampa, FL.**
The study objectives were to evaluate the association between EMS agency-level pain management options and analgesia administration and identify any differences by race/ethnicity among patients with long bone fractures. We conducted a retrospective analysis using the 2021 ESO Data Collaborative. We included patients with hospital-diagnosed long bone fractures, presenting alert and with acute pain in the prehospital setting (initial pain scores >5), who were transported by advanced life support agencies. We excluded interfacility transfers, encounters with <2 pain scores, or with analgesia administered prior to arrival. Based on medications administered in the study year, agency-level analgesia options were evaluated for nonopioids and noninvasive routes (intranasal, oral, inhaled). We used multivariable generalized estimating equations to account for agency clustering and estimate adjusted odds ratios (aOR) and 95% confidence intervals (95% CI) for prehospital analgesia by agency analgesia options, adjusting for fracture type, age, transport interval, and race/ethnicity. We analyzed records for 14,560 patients transported by 423 agencies. All agencies carried opioids and delivered medications intravenously or intramuscularly. Additionally, most agencies had non-opioids and noninvasive

routes available (79%, n ¼ 336). Forty-nine (12%) agencies carried nonopioids but used only invasive routes and 22 (5%) agencies only carried opioids and used invasive routes. There was a seven-fold increase in odds of analgesia for patients treated by agencies that carried non-opioids and noninvasive routes compared to agencies carrying only opioids and invasive routes (aOR: 7.37, 95% CI: 4.72–11.50). Nevertheless, Black patients had 35% lower odds of receiving analgesia compared to their White counterparts (aOR: 0.65, 95% CI: 0.55–0.76).

55. **Mat Goebel, Larrite D. Reed, R. J. Lolley, Taylor K. Ratcliff, Jeffrey L. Jarvis. Intraosseous Access Location Does Not Change Rates of Return of Spontaneous Circulation in Prehospital Cardiac Arrest. NAEMSP 2023. Tampa, FL.**
The study objective was to evaluate the association of upper vs lower extremity IO location with the return of spontaneous circulation (ROSC) in OHCA. We analyzed the ESO 2020 research dataset, including all 9-1-1 responses for adult cardiac arrest cases who received medications via IO. Patients were excluded if they also received medications by IV, had DNR orders or obvious signs of death, had both upper and lower extremity or non-extremity IO access, had missing outcome data, or if the estimated interval from collapse to CPR was >60 minutes. The primary outcome was ROSC at ED arrival. We calculated odds ratios with 95% confidence intervals using logistic regression, adjusting for common Utstein variables. The final cohort consisted of 15,717 cases. The median age was 65 (IQR 53–76), 60% were male. The most common initial rhythm was non-shockable (84%). Approximately 76% (11,993) used lower extremity IO access, and 24% (3,724) used upper extremity access. There was a 2% absolute difference in ROSC favoring upper vs lower S31 extremity IO (33% vs 31%, p < 0.01). After adjusting for common Utstein confounders there was no difference in ROSC between upper and lower extremity IO location (aOR 0.91, 95% CI 0.80–1.04).

56. **Benjamin A. Lang, Lawrence H. Brown, Remle P. Crowe, Katherine E. Remick. EMS Encounters for Pediatric Behavioral Conditions: Interventions and Inequities. NAEMSP 2023. Tampa, FL.**
The aim of the study was to describe behavioral health presentations among pediatric EMS patients, determine the frequency and types of restraint or sedation, and assess for disparities in those interventions. Using the ESO Research Collaborative database for 2018–2021, we identified patients ages 5 to 17 years presenting to EMS with behavioral conditions (e.g., “behavioral/ psychiatric episode”; “intentional self-harm”). We excluded patients with clinical presentations that might explain their behavioral conditions (e.g., seizures, hypoglycemia). SES was measured by scene location Social Vulnerability Index (SVI). We determined the frequency of physical restraint and sedation using procedures and medications documented by the EMS clinicians. We used multivariable logistic regression to assess for associations between patient characteristics and restraint or sedation. Of 1,179,972 EMS encounters with 5 to 17-year-olds, 208,926 patients presented with behavioral conditions. Mean age was 14 ± 3 years; 53.1% were age 15–17, 39.8% were age 10–14, and 7.1% age 5–9. The sample was 58.9% female; 51.5% of the patients were White, non-Hispanic. Physical restraints were used in 4,942 (2.4%, CI: 2.3%–2.1%) of encounters; sedation was administered in 3,897 (1.9%, CI: 1.8%–1.9%). Both restraint and sedation occurred in 1,279 (0.6%, CI: 0.6%–0.7%) encounters. Restraint did not vary by age, but was more common among male (OR ¼ 1.71, CI: 1.62–1.82) and nonwhite (OR ¼ 1.27, CI; 1.19–1.36) patients; sedation was more common among 15–17 year-olds (OR 1.32, CI: 1.23–1.41), male (OR ¼ 1.52, CI: 1.42–1.62), and nonwhite (OR ¼ 1.21, CI; 1.13–1.30) patients. Neither restraint or sedation was associated with SVI quartile, although there were significant interaction effects between race and SVI quartile.

57. **Brett D. Meyer, Nathaniel Thomas, Ignacio Rodriguez, Samuel Schow, Sydney Jarvis, John Gonzales, J. Brent Myers, Remle P. Crowe. Agency-Level Disparities in Prehospital Analgesia Rates for Black Patients with Severe Acute Traumatic Pain. NAEMSP 2023. Tampa, FL.**
The study objective was to assess agency-level variation in prehospital analgesia rates by patient race. We conducted a retrospective cohort analysis using the 2021 ESO Data Collaborative. We included 9-1-1 patients presenting with acute traumatic pain (initial pain score > 6), transported by advanced life support units. Records were excluded if analgesia was provided prior to arrival

of the transporting unit. We excluded agencies with fewer than 52 records in the sample (~1 per week) or fewer than 10 White and 10 Black patients to generate more stable estimates. We calculated agency dissimilarity indices as the analgesia rate for White patients minus the analgesia rate for Black patients attended by the same EMS agency. We analyzed records from 421 agencies representing 206,561 encounters for patients with severe acute traumaticc pain. The median agency-level analgesia rate was 32% (IQR: 20%–47%) for White patients and 20% (IQR: 11%–30%) for Black patients. The median dissimilarity index was 11% (IQR: 5%–18%) disfavoring Black patients. The analgesia rate was at least 10 percentage points higher for White patients compared to Black patients at 231 (55%) agencies. Agencies with smaller dissimilarity indices (<10%) tended to have lower overall analgesia rates (median analgesia rate: 20%, IQR: 12%–31%) compared to agencies with dissimilarity indices >10% (median analgesia rate: 36%, IQR: 25%–46%).

58. **Antonio Ramon Fernandez, Remle P. Crowe, Scott S. Bourn, J. Brent Myers. EMS Data Mirror National Case Counts for COVID-19 Surveillance. NAEMSP 2023. Tampa, FL.**
The study objective was to compare EMS data with national case counts to determine if EMS data can reliably surveil COVID-19. This retrospective study compared all 9-1-1 responses with a COVID-19 clinician impression in the ESO Data Collaborative to New York Times (NYT) reported national COVID-19 case counts. The study period was 3/6/ 2020-7/24/2022 (3/6/2020 was the first day COVID-19 impressions were available). ESO and NYT data were evaluated independently. Results were then combined for comparison. A wave of COVID-19 were defined as a rapid increase in case counts, a peak, a rapid decrease in case counts, and a nadir. A rapid increase was identified by a consistent daily increase in the 7-day case average. A consistent daily decrease in 7-day case average identified a rapid decline. Dates for each phase of each wave were documented. Differences in days between EMS and NYT data were calculated. Negative differences represent EMS identifying the wave characteristic first, while positive differences represent NYT identifying the wave characteristic first. During the study period, seven distinct waves were identified. The median difference in identifying the start of each wave was 2 days (IQR: -1.5 to 6). The median difference in identifying the peak of each wave was -3 days (IQR: -5.25 to 1.25). The median difference in identifying a consistent decline was -3.5 days (IQR: -5.5 to -3). Finally, the median difference in identifying the nadir was 1 day (IQR: -3.25 to 5.25).
59. **Stephanie Ashford, Benjamin Lang, Stephen Harper, Matthew Levesque, Daniel Strudevant, Scott Bourn, Antonio R. Fernandez. Pediatric Prehospital Respiratory Emergency Encounters: Assessment & Intervention Relationships (PHREE AIR). NAEMSP 2023. Tampa, FL.**
The study objective was to determine if documented pediatric respiratory assessments are associated with increased interventions and improved patient outcomes. This retrospective cohort study evaluated all EMS patient care records (PCR) from the 2021 ESO Data Collaborative public use dataset. The cohort consisted of all patients under the age of 18 years of age with primary or secondary impressions that were respiratory in nature from January 1, 2021, to December 31, 2021. The analysis was limited to 9-1-1 responses. NEMSQA defines a respiratory assessment as evaluating respiratory rate and pulse oximetry (SpO2). EMS interventions were performed if at least one respiratory medication or procedure was documented. Descriptive statistics were calculated. Where appropriate, S70 NAEMSP 2023 ANNUAL MEETING ABSTRACTS chi-square tests, Fisher's exact tests, and univariable logistic regression were performed. There were 8,296,774 9-1-1 responses in 2021. Of those, 50,004 were pediatric PCRs with documented "acute respiratory distress" from 1645 EMS agencies, 96% (48,100) had NEMSQA-defined respiratory assessments documented at least once in a call. Patients with a NEMSQA-defined respiratory assessment had over seven times higher odds of EMS interventions being performed (OR: 7.5, 95% CI 6.34–8.90). Patients who had respiratory assessments performed also had three times higher odds of EMS transport (OR: 3.13, 95% CI: 2.84–3.45). There was no difference in admissions (OR: 0.5 CI 0.19–1.27) or mortality (OR: 0.26, 95% CI: 0.06–1.11) when comparing those who had assessments and those who did not

60. Remle Crowe, Antonio R. Fernandez, Scott S. Bourn, J. Brent Myers. Changes in EMS Encounters for Patients with Firearm Injuries during the COVID-19 Pandemic. NAEMSP 2023. Tampa, FL.
The study objective was to compare EMS encounters for patients with firearm injuries prior to and during the COVID-19 pandemic. This retrospective analysis used prehospital patient care records from the ESO Data Collaborative. We limited the analysis sample to EMS agencies that were part of the collaborative in CY 2019 and CY 2021. All 9-1-1 records for patients with documented injuries from firearms were included. We excluded interfacility transports. As expected mortality differs for injuries resulting from assault or accidental discharges compared to intended self-harm, we excluded encounters with self-harm or unknown intent from the mortality analysis. Percent change was calculated for 2021 compared to 2019. We analyzed records from 1,194 EMS agencies. The total number of 9-1-1 responses increased by 6% from 5,438,898 in 2019 to 5,751,108 in 2021. Meanwhile, the number of EMS encounters involving firearm injuries increased by 30% from 13,958 to 18,184. Assault was the most common intent documented in 2019 (55%, 7,720) and 2021 (53%, 8,610). Encounters with unknown intent increased by 61% from 2019 (2,423) to 2021 (3,893), while encounters related to self-harm and those related to accidental injuries remained similar. The median age was similar in 2019 (31 years; IQR:23–46) compared to 2021 (30 years; IQR: 22–43); however, the number of encounters for children <18 years increased by 70% from 957 in 2019 to 1,626 in 2021. After excluding encounters involving self-harm or unknown intent, on scene mortality for injuries from assault or accidental discharges was 9% (768) in 2019 and 10% (1,103) in 2021.
61. Alyssa Morgan Green, Kevin J. Keenan, Antonio Fernandez, Brent Myers, Remle Crowe. Factors Associated with Unrecognized Acute Ischemic Stroke among EMS Transported Patients. NAEMSP 2023. Tampa, FL.
The study objective was to identify factors related to EMS recognizing stroke in patients diagnosed with acute ischemic stroke. This retrospective analysis used the 2019 ESO Data Collaborative public use research dataset to analyze linked prehospital and hospital records. Patients diagnosed with acute ischemic stroke were identified by hospital ICD 10 code. We excluded patients with decreased level of consciousness, cardiac arrest, non-9-1-1 encounters, and patients without hospital diagnoses. EMS stroke recognition was identified using primary impression, secondary impression, protocol used, stroke alert, and/or documented stroke screen. Univariable logistic regression models were used to analyze the relationship between patient/encounter characteristics and EMS stroke recognition. Odds ratios (OR) and 95% confidence intervals (95% CI) are reported. We analyzed 5,939 records for EMS-transported patients diagnosed with acute ischemic stroke. Median patient age was 72 years (IQR: 62,82). Male patients made up 49% of the cohort. Injury was noted in 7% (n =428) of patients. EMS recognized stroke in 61% (n ¼ 3,623) of patients. There was a three-fold increase in odds of stroke recognition when responding emergent (OR: 3.51, 95% CI: 2.93–4.23). Patients with injuries had 71% lower odds of EMS recognizing stroke (OR: 0.29, 95% CI: 0.24–0.36). Odds of stroke recognition were 13% lower for female patients compared to males (OR: 0.87, 95% CI: 0.78–0.97). Additionally, odds of EMS stroke recognition were 25% lower for Hispanic patients (OR: 0.75, 95% CI: 0.61–0.94) and 21% lower for Black patients (OR: 0.79, 95% CI: 0.7–0.9) compared to White patients.
62. Woody S. Green, Amar Vira, James M. Kempema, Lawrence H. Brown. Timing of Ultrasound in Non-Arrhythmogenic Out-of-Hospital Cardiac Arrest: Re-Thinking Its Role. NAEMSP 2023. Tampa, FL.
The purpose of this study was to describe the current timing of ultrasound use in non-arrhythmogenic out-of-hospital cardiac arrest. We queried the 2019–2021 ESO Research Collaborative dataset to identify 9-1-1 responses for patients 15 years of age or greater who had non-arrhythmogenic cardiac arrest and documented use of prehospital ultrasound. We describe the elapsed time from patient encounter (or time of arrest for EMS-witnessed arrests) until first documented ultrasound, as well as the elapsed time from first ultrasound until termination of resuscitation for encounters with field termination. We also report the same data for the subset

of patients with traumatic non-arrhythmogenic arrests. Ultrasound use was documented in 462 patients with non-arrhythmogenic cardiac arrest. The median (IQR) elapsed time from initial encounter until first ultrasound was 23 (16–30) minutes. For the 348 encounters with field termination of resuscitation, the elapsed time from first ultrasound until termination was 4 (2–8) minutes. In the subset of 38 patients with traumatic arrest, the elapsed time from initial encounter until first ultrasound was 12 (7–21) minutes; in the 31 traumatic arrests with field termination the elapsed time from first ultrasound until field termination was 3 (1–5) minutes.

63. Remle P. Crowe, Antonio R. Fernandez, Scott S. Bourn, J. Brent Myers. Anatomic and Physiologic Factors Related to Survival to Hospital Discharge among EMSTransported Patients with Firearm Injuries. NAEMSP 2023. Tampa, FL.
The study objective was to describe mortality rates for EMS-transported patients with firearm injuries and identify factors related to survival to hospital discharge. We retrospectively analyzed prehospital records with linked hospital data from the 2021 ESO Data Collaborative to evaluate survival to hospital discharge. Cardiac arrests prior to EMS arrival were excluded. We used multivariable logistic regression to identify factors related to survival including patient age, sex, Glasgow Coma Scale (GCS) <8, elevated shock index (SI) >1.0, injury intent (assault, accidental, self-harm, unknown), anatomic location (extremity, head, trunk, multiple), scene interval, and prehospital interventions (intravenous fluid, chest seal, pleural decompression, tourniquet, spinal motion restriction). We analyzed 3,813 EMS-transported patients with firearm injuries. After excluding 239 patients who were transferred, still patients, or lost to follow-up, 94% (3,574) were analyzed. Median age was 29 years (IQR: 21–28). Median scene interval was 7.9 minutes (IQR: 5.2–11.5) and 7.8% (277) had spinal motion restriction. The mortality rate ranged from 1.7% (6/347) for accidental injuries to 65.0% (118/183) for self-harm injuries. Mortality rate varied by anatomic location from 0.6% (9/1,493) for isolated extremity injuries to 42.9% (191/445) for head injuries. Multivariable modeling revealed no effect on survival for any prehospital procedure; however, GCS <8 (aOR: 0.02, 95% CI: 0.01–0.03; referent GCS > 8), elevated SI (aOR: 0.34, 95% CI: 0.20–0.58; referent: SI <1.0), self-harm (aOR: 0.37, 95% CI: 0.16–0.86; referent: assault), and injury of the head (aOR: 0.03, 95% CI: 0.01–0.11), trunk (aOR: 0.07, 95% CI: 0.02–0.25), or multiple areas (aOR:0.05, 95% CI: 0.02–0.19; referent: isolated extremity) were associated with significantly reduced odds of survival.

64. Daniel P. Burke, Antonio R. Fernandez, Remle P. Crowe, J. Brent Myers, Rebecca E. Cash. Disparities in EMS Transport Intervals for Patients with Pregnancy-Related Conditions in Washington, DC. NAEMSP 2023. Tampa, FL.
The study objective was to describe prehospital utilization patterns by women with pregnancy-related concerns by race/ethnicity and socioeconomic status in Washington, DC. In this retrospective analysis we analyzed all prehospital care records submitted to the DC Department of Health in calendar year 2021. Records were included in the analysis if the requested service was a 9-1-1 response and the clinician impression ICD 10 code was consistent with pregnancy, childbirth, or puerperium. The CDC Social Vulnerability Index Socioeconomic Theme was used to evaluate socioeconomic status (SES) of the scene census tract. Chi-square and Wilcoxon rank sum statistics were calculated. Pregnancy-related conditions represented 1% (n = 1,661) of the 155,104 EMS encounters in 2021 in DC. The median age of patients with pregnancy-related conditions was 27 years (IQR: 23 to 32). A substantially larger proportion of patients with pregnancy-related conditions were Black or African American (91%; n ¼ 1,513) compared to all patients encountered by EMS in that year (69%; n = 107,248). Additionally, more patients with pregnancy related conditions were classified in the most socioeconomically vulnerable quartile compared to all 9-1-1 encounters (57%; n = 950 versus 42%; n = 54,925). Most encounters (60%; n = 999) resulted in EMS transport and all destinations were OB-capable. Median transport intervals were 4.5 minutes longer for Black/African American compared to White patients (13.5 minutes vs 9.1 minutes, p = 0.01). Similarly, median transport intervals were 6.8 minutes longer for patients in the most vulnerable SES category compared to the least vulnerable category (15.3 minutes vs 8.5 minutes, p < 0.01).

65. Jordan Thomas, Remle Crowe, Kevin Schulz, Henry E. Wang, Marcia C. De Oliveira Otto, Benjamin Karfunkle, Ryan Huebinger. Association between Agency Intubation Rate and Intubation Success. NAEMSP 2023. Tampa, FL.
The study aim was to evaluate the association between agency intubation frequency and intubation success using a national prehospital database. We combined the 2018 and 2019 ESO prehospital databases, including all adult cases where endotracheal intubation was performed. We then calculated the number of intubations attempted per 1,000 EMS responses, transports, and advanced life support (ALS) transports for each agency. We excluded cases originating at hospitals or emergency departments and agencies with less than one intubatation (66 agencies) or more than 100 (four agencies) intubations per 1,000 responses. We described encounter characteristics and agency characteristics. We used mixed model logistic regression to evaluate the association between agency intubation frequency and intubation success at any point during encounter and first pass success. We adjusted for patient and encounter characteristics and fit agency ID as a random intercept. We included 1,025 agencies performing intubations on 62,708 patients. Median age was 65 and 61.8% were male. The majority of responses occurred at home (67.3%). Intubation success rate was 78.9% and first pass success rate was 71.8%. Per agency, the median number of responses was 4,311 (IQR 1,855–11,082) and the median number of intubations was 33 (IQR 11–80). Median agency intubation rate per 1,000 EMS responses was 8 (IQR 6–11). The frequency of intubations per 1000 EMS responses was associated with increased intubation success (aOR 1.05, 95% CI 1.04–1.07). However, the number of intubations per 1,000 transports (aOR 1.0, 95% CI 1.0–1.0) and intubations per 1,000 ALS transports (aOR 1.0, 95% CI 1.0–1.0) were not associated with intubation success. Additionally, intubation frequency was not associated with first pass success.
66. Amelia M. Breyre, Remle P. Crowe, Antonio R. Fernandez, Alexandra Jabr, J. Brent Myers, Douglas F. Kupas. Emergency Medical Services Clinicians Are Increasingly Exposed to Death and Tasked with Death Notification. NAEMSP 2023. Tampa, FL.
The study objective is to describe changes in EMS encounters involving on-scene death from 2018 to 2021. We retrospectively analyzed de-identified EMS records for 9-1-1 responses from the ESO Data Collaborative, from 2018 to 2021. Analysis was limited to agencies that contributed records over all four study years. We included patient dispositions of death on-scene, with or without attempted resuscitation, and without EMS transport to identify cases of on-scene death where EMS likely communicated a death notification. We report descriptive statistics at the agency and clinician level. A non-parametric test of trend was used to assess for monotonic increase in agency-level encounters involving on-scene death and the proportion of EMS clinicians exposed to at least one on scene death from 2018 to 2021. ReWe analyzed records from 1,109 EMS agencies. These agencies responded to 4,286,976 calls in 2018, 5,097,920 calls in 2019, 4,939,651 calls in 2020, and 5,347,40 calls in 2021.The total number of encounters with death on scene rose from 49,802 in 2018 to 60,542 in 2019 to 76,535 in 2020 and 80,388 in 2021. Agency-level annual counts of encounters involving death on-scene rose from a median of 14 (IQR: 4–40) in 2018 to 23 (IQR: 6–63) in 2021 (p-trend <0.001). In 2018, 56% of EMS clinicians responded to a call with death on-scene while this number rose to 63% of EMS clinicians in 2021 (p-trend <0.001).
67. Alyssa Morgan Green, Adiel Garcia Cuellar, Paul Gallo, Caroline Schwester, David Wampler, Remle Crowe, Brent Myers, Jeffrey L. Jarvis. The Association between Negative Prehospital Spinal Motion Restriction Screening and Spinal Cord Injury. NAEMSP 2023. Tampa, FL.
The study objective was to examine the association between negative prehospital NEXUS criteria and SCI requiring hospital admission. This retrospective analysis used the 2021 ESO Data Collaborative dataset to analyze linked prehospital and hospital records for trauma patients from 9-1-1 activations. Patients admitted with SCI were identified using ICD10 diagnosis codes. An age-adjusted logistic regression model was used to analyze the relationship between SCI and NEXUS criteria, overall and by components. Results: We analyzed 288,309 EMS encounters for trauma patients with hospital outcomes. SCI occurred in 197 (<0.01%) patients, with 164

resulting hospital admission. Among admitted patients with SCI, 64 (39%) had documented prehospital NEXUS SMR screens. Of these, 9 (14%) had negative prehospital SMR screens. After adjustment for age, a negative SMR screen was associated with lower odds of SCI, aOR 0.14 (0.06–0.27), however the sensitivity of a negative SMR screen was only 86% (75–93%).

68. John F. Ryan, Tabitha A. Cheng, Remle P. Crowe, J. Joelle Donofrio-Odmann. Prehospital Assessment and Treatment of Infants and Toddlers in Respiratory Distress. NAEMSP 2023. Tampa, FL.
The study objective was to describe EMS assessment, identification, and treatment of patients under 3 years old with upper and lower airway conditions. This retrospective analysis used linked prehospital and hospital records from the 2018 and 2019 ESO Data Collaborative (containing electronic health records for >1,300 agencies). We included 9-1-1 transports of patients ages 1 day to 3 years with ICD-10 diagnosis codes indicating upper (croup) or lower (bronchiolitis, asthma) airway disease. We excluded patients with tracheostomy or cardiac arrest. We reported patient demographics, documentation of respiratory rate (RR) and pulse oximetry (Sp02), EMS primary impressions, and treatments using descriptive statistics. Results: We included 1,352 records, of which 25.6% (n = 346) were upper respiratory diagnoses. Patients with upper airway diagnoses tended to be older compared to those with lower airway diagnoses (e.g., 1–3 years age category: 73.4% vs 56.8%), were more commonly male (71.0% vs 57.2%), and were more likely to be discharged home from the ED (87.8% vs 59.5%). Sp02 and respiratory rate were not documented for 8.2% (n = 111) and 2.7% (n = 36) of patients, respectively. For upper airway diagnoses, the top three EMS primary impressions were “acute respiratory distress” (60.4%), “laryngitis/croup” (13.9%), and “cough” (5.5%). EMS treated upper airway conditions most commonly with oxygen (33.2%), albuterol (28.9%), and nebulized epinephrine (25.5%). Among patients with lower airway diagnoses, the top three EMS primary impressions were “acute respiratory distress” (50.0%), “fever” (9.2%), and “common cold” (4.4%). EMS most commonly treated lower airway conditions with oxygen (39.6%), albuterol (31.5%), and ipratropium (10.7%).
69. Antonio Ramon Fernandez, J. Brent Myers, Remle P. Crowe, Anjni Joiner, Douglas F. Kupas. Outcomes for Older Adults Treated by EMS for Falls in Communal Living Facilities. NAEMSP 2023. Tampa, FL.
The study objective was to describe characteristics and outcomes of patients in communal living facilities encountered by EMS for falls. This national retrospective study examined 9-1-1 responses from the 2021 ESO Data Collaborative. All older adults (>65 years) who experienced falls with scene locations documented as communal living facilities (e.g., assisted living centers, mental health facilities) were included. Interfacility transports, no patient found, and cardiac arrests were excluded. Patient demographics, EMS transport status, and patient outcomes were described. Results: Of the 9,430,066 9-1-1 responses in 2021, 1.4% (n = 128,433) were for older adults who fell in communal living facilities. The median age was 85 years (interquartile range: 78–91) and two-thirds were female (68%; n = 86,646). Of the 89% (n = 114,258) for whom race/ethnicity was documented, most were documented as White (91%, n = 104,761), 5% (n ¼ 5,454) Black, 3% (n = 2,842) Hispanic/ Latino(a), and 1% (n = 1,201) were categorized as other race. EMS transport occurred for 88% (n = 112,949). Among transported patients, 23% (n = 26,032) had linked ED outcomes, of which 65% (n = 17,010) were discharged from the ED, 30% (n = 7,887) were admitted, 4% (n = 1,006) transferred, <1% (n ¼ 117) entered hospice or were still ED patients at the end of the study period, and <1% (n = 47) died in the ED. Hospital dispositions were available for 93% (n = 7,316) of admitted patients. Of those, 77% (n = 5,619) were discharged (15% [1,130/7,316] to non-communal living facilities, 11% (n = 778) transferred, 8% (n = 572) entered hospice, 4% (n = 315) died, and <1% (n = 32) were still patients at the end of the study period.
70. Sean MacAllister, Antonio R. Fernandez, Michael J. Smith, Remle P. Crowe. Racial Disparities in Outcomes for Patients with Sepsis Transported by EMS. NAEMSP 2023. Tampa, FL.
The study objective was to describe patient mortality by race, accounting for EMS sepsis recognition and socioeconomic status (SES). This retrospective cohort study used linked EMS

and hospital records from the 2021 ESO Data Collaborative. We included 9-1-1 encounters for adult patients (>18 years) with ICD-10 diagnosis codes indicating sepsis. EMS sepsis recognition was defined as a primary or secondary sepsis impression, use of an EHR specialty sepsis form, or a sepsis alert. SES was measured using the CDC Social Vulnerability Index. Sepsis recognition by race was compared using a chi-square test. Multivariable logistic regression modeling was used to assess the association between race and mortality for patients with sepsis adjusting for EMS recognition, SES, and clinical sepsis characteristics: altered mental status, hypotension, tachypnea, tachycardia, fever. We analyzed 20,172 records for EMS patients diagnosed with sepsis. Overall, 72% were White, 18% were Black, 8% were Hispanic. Median age was younger for Black (64, 53–74) and Hispanic (65, 50–77) patients compared to White patients (72, 61–81). EMS recognized sepsis in 18% (3,553) of patients. Sepsis recognition was similar across races (White: 18.1%, Black: 17.2%, Hispanic: 17.4%, p = 0.23). Overall mortality was 11% (2,186). After adjustment for age, sex, socioeconomic status, clinical sepsis characteristics, and EMS sepsis recognition, Black patients had 25% greater odds of mortality (OR: 1.25, 95% CI: 1.09–1.44) compared to White patients. Odds of mortality did not differ for Hispanic patients compared to White patients (OR: 1.01, 95% CI: 0.91–1.34).

71. **Louis B. Fornage, Christine O'Neil, Stephen R. Dowker, Eric R. Wanta, Ryan S. Lewis, Lawrence H. Brown. Prehospital Intervention Improves Outcomes for Patients in Atrial Fibrillation with Rapid Ventricular Response. NAEMSP 2023. Tampa, FL.**
The purpose of this study was to compare outcomes of such patients presenting to EMS based on the prehospital treatment they received. This retrospective cohort study used the 2021 ESO Research Collaborative (Austin, TX) dataset. We identified 9-1-1 scene responses for patients aged 16 to 100 years old with initial EKG interpretations as atrial fibrillation and initial heart rates >110/min. Prehospital interventions included vagal maneuvers, medications, and electrical cardioversion. The primary outcome measure was frequency of emergency department (ED) discharge to home; secondary outcomes included hospital length-of-stay (LOS) for admitted patients, and in-hospital mortality. We used propensity score matching to compare results among patients with similar demographics, clinical characteristics, and comorbidities. We reported the adjusted difference in outcomes, number needed to treat (NNT), and 95% confidence intervals (CI). There were 10,234 eligible patients with hospital outcome data. After propensity matching, 8,832 patients were retained in the analysis: 1,376 (15.6%) with prehospital intervention and 7,456 (84.4%) without intervention. ED discharge to home occurred for 37.4% of the intervention patients and 28.9% of the nonintervention patients (adjusted difference þ7.6%, CI 3.6%–11.6%; NNT 14, CI 9–28). Among admitted patients, median (IQR) LOS was 4 (2.3–7.2) days for intervention patients versus 4.8 (2.9–7.9) days for nonintervention patients (adjusted difference -0.7 days, CI -1.3–-0.1). Mortality was 3.9% for intervention patients and 7.2% for nonintervention patients (adjusted difference -2.9%, CI -4.8%–-1.0%; NNT 35, CI 21–100).
72. **Henry Wang, Mengda Yu, Ching MIn Chu, Travis Sharkey-Toppen, J. Madison Hyer, Michelle Nassal, Alix Delamare, Jonathan Powell, Lai Wei, Ashish Pancha. Chronic Oral Anticoagulant Use by Emergency Medical Services Patients in the United States. NAEMSP 2023. Tampa, FL.**
The purpose of this study was to describe the national characteristics of patients with a history of OAC use. We used the 2018–2020 ESO data set. We included adults (age >18 years) receiving 9-1-1 EMS care. OAC use included warfarin, dabigatran, rivaroxaban, and apixaban. We determined the incidence of EMS calls by OAC users and their variation by EMS agency. We compared EMS call, patient, and response characteristics between OAC and non-OAC users, including primary impressions and hospital diagnoses. Among 2,100 EMS agencies, there were 16,244,550 adult 9-1-1 EMS events, including 948,671 by OAC users (58 per 1,000 events). OAC call incidence varied by EMS agency; median 53 per 1,000 events (IQR 27 to 83). Compared with non-OAC users, OAC users were more likely to be >70 years (64.6% vs. 30.3%, OR 4.19, 95% CI: 4.17 to 4.21), White race (77.4% vs. 65.8%, OR 2.62, 95 CI: 2.47 to 2.78), and non-Hispanic (84.4% vs. 78.0%, OR 2.66, 95% CI 2.63 to 2.69). Calls involving OAC users were more likely at nursing homes (17.9% vs. 9.1%, OR 2.16, 95% CI: 2.14 to 2.17) but less likely to

involve trauma (17.8. vs. 21.6%, OR 0.787, 95% CI: 0.783 to 0.791) or cardiac arrest (1.2 vs. 1.4%; OR 0.89, 95% CI: 0.87 to 0.90). Among OAC users, the most common EMS primary clinical impressions were chest pain (7.4%), altered mental status (7.3%), injury (6.5%), abdominal pain (4.3%), and brain injury (2.8%). Among the 67,567 OAC EMS encounters linked to hospital data, the most common primary discharge diagnoses were ICD10 R00-R99 signs and symptoms (23.1%), I00-I99 circulatory diseases (19.9%), and J00-J99 respiratory diseases (10.1%).

73. **Rebecca E. Cash, Kori S. Zachrison, Remle P. Crowe, Scott A. Goldberg, Greg A. Peters, Krislyn M. Boggs, Carlos A. Camargo, Jr. Creation of a Novel National Dataset through EMS Transport Destination and ED Capability Linkage. NAEMSP 2023. Tampa, FL.**
The study objective was to link EMS transport destinations in a national dataset with verified ED capability data to develop a novel dataset to better understand prehospital routing practices. We linked two cross-sectional databases: the 2021 ESO Data Collaborative and the 2019 National Emergency Department Inventory (NEDI)-USA. The ESO Data Collaborative contains de-identified prehospital patient care records from nearly 2,000 participating EMS agencies across the U.S. NEDI-USA is an annual survey of all nonfederal, non-specialty U.S. EDs open 24/7/365 (including freestanding EDs), with verified data on stroke, trauma, and burn capabilities. From ESO, we obtained all unique destinations designated as “hospital” (>1 address per hospital possible—e.g., ED and main entrance addresses). After verifying addresses were NEDI-eligible EDs (i.e., providing emergency services 24/7/365), we performed a three-step linkage process to NEDI-USA: (1) name/address exact matches; (2) probabilistic “fuzzy” matching on name/address based on bigrams, accepting adequate (>85%) match scores after review; and (3) hand-matching using Google Maps. We calculated descriptive statistics to describe the linkage process. Of the 9,299 unique “hospital” destinations in the EMS dataset, 2,525 (27%) were found to be non-hospital facilities (e.g., nursing home, dialysis clinic, medical office) or were non-NEDI-eligible (e.g., specialty hospital such as a psychiatric facility). We linked 93% (n = 6,329/6,774) of NEDI-eligible EMS hospital transport destinations to EDs in NEDI-USA. Excluding duplicate addresses, the linked addresses represented 3,826 unique EDs in 49 states, which included 68% (n = 3,826/5,590) of the EDs included in the 2019 NEDI-USA database.

74. **Adelgais, K., Broad, A., Leonard, J. Characteristics of Abusive Head Trauma in Young Children Transported by Emergency Medical Services. American Academy of Pediatrics 2022 National Conference & Exhibition. Anaheim, California.**
The purpose of this study is to describe patient demographic and clinical factors and EMS primary impression and interventions associated with a diagnosis of AHT in preverbal children. This secondary data analysis utilized data from the ESO Heald data Exchange database. Over the study period, there were 179,546 encounters of children <36 months of which 624 had a hospital diagnosis of AHT (0.35%). Median age was 1 year (0-2), 53% were male, median EMS GCS was 15, and 47% were transported by ALS. In our cohort, 79.3% (n=495) were coded as being a "traumatic" encounter with the following top 5 EMS primary impressions: Injury of Head/Face (35.7%), Traumatic Injury (21.3%), Injury (31.2%), No Complaints or Injury/Illness Noted (7.3%). Overall, 7.5% had IV access (n=47), 2.4% (n=15) received medication, and 7.5% received airway management most receiving supplemental oxygen (63%). Top medications included epinephrine (n=7), benzodiazepines (n=6), and analgesics (n=6). Non-febrile seizures accounted for 13 encounters of which half received midazolam. Overall, 12% (n=74) of patients were admitted and among those with a documented hospital length of stay, the median was 3 days; 6 patients (1%) died. AHT remains an occult diagnosis in preverbal children and further research characterizing EMS clinical impressions and rationale for treatment decisions in this high-risk patient population are needed.

75. **Adelgais, K., Broad, A., Leonard, J., Wheeler, S., Zhang, z., Luo, X. Factors associated with Abusive Head Trauma in Young Children Presenting to Emergency Medical Services using Machine Learning, and Natural Language Processing. American Academy of Pediatrics 2022 National Conference & Exhibition. Anaheim, California.**

The purpose of this study was to apply ML and NLP to free-text narrative documentation in EMS encounters of young children with AHT and describe potentially novel factors associated with this condition. A secondary analysis of the ESO Research Data Collaborative database was conducted. There were 697 encounters with a hospital diagnosis of Abusive Head Trauma. After chart review, 623 AHT cases met inclusion criteria with 74 encounters excluded for the following: motor vehicle collision (n=43), interfacility transfer (n=15), or age >36 months (n=16). Among the ML algorithms, Random Forest performed the best with AUROC 0.901, specificity 97.4%, and sensitivity 94.4%. (Figure 1) Using SHAP to interpret the trained Random Forest model (Figure 2), words positively correlated with AHT included "blood" (s=0.033), "objects" (s=0.026), "hands" (s=0.022), "fell" (s=0.020), "abrasions" (s=0.018), "avulsion" (s=0.010) and "cut" (s=-0.009). Words negatively correlated with AHT included "mva" (s=-0.055), "mvc" (s=-0.045), "transported" (s=-0.029), "fracture" (s=-0.021), "pole" (s=-0.017), "vehicle" (s=-0.015), and "facility" (s=-0.007). Research is needed to evaluate the benefit of real time computerized decision support on identifying sentinel injuries documented by EMS as an aid to detecting AHT in young children.

76. **Harrell, AL., Rosner, J., Hodges, JB., Crowe, RP., Myers, JB., Fernandez, AR. Evaluating the level of care provided to EMS patients in Virginia when a paramedic was on-scene. The annual meeting of the National Association of State EMS Officials. 2022. Charleston, South Carolina.**
The objective of this study was to evaluate the level of care provided to patients who were treated and transported by Virginia EMS agencies during 9-1-1 responses and intercepts which had a paramedic on-scene. This retrospective study evaluated all EMS events submitted between July 1 and December 31, 2021 to the Virginia EMS Data Repository, provided by ESO. Inclusion criteria were: 1) a response type documented as a 9-1-1 response or intercept, 2) documentation of a paramedic on-scene, 3) successful passage of state data validation (in the NEMSIS 3.4 standard), and 4) a disposition consistent with patient treatment and transport. Each EMS event was then evaluated to determine if a paramedic-level provider was required based on the interventions performed. The top five most frequently documented EMS Provider Primary Impressions were compared among events where a paramedic-only level intervention was performed and those where a paramedic-only level skill was not performed. More than 4 of every 10 EMS transport events where there was a paramedic on scene did not have a paramedic-level intervention performed. There was little difference in providers' primary impressions among events where a paramedic-level intervention was performed and where a paramedic level skill was not performed. 158,257 encounters were found to have a paramedic on-scene and an intervention documented in the prehospital care report and were included in the analysis. Of the records with an intervention reported, 15.5% (24,499) had only BLS- or ALS-level interventions documented.

77. **Messer, MT., Ezzell, D., Mitchell1, T., Lewis, C., Emig IV, DA., Crowe, RP., Myers, JB., Fernandez, AR. Describing the impact of paramedic degree requirements in North Carolina. The annual meeting of the National Association of State EMS Officials. 2022. Charleston, South Carolina.**
The objective of this study was to describe the education level of recent graduates of initial paramedic training programs in North Carolina. This retrospective analysis included data from the NC State EMS Data Repository, provided by ESO (Austin, TX). Education levels and demographics for every paramedic student that successfully completed an initial training program and that was currently on an EMS agency roster in NC from January 1, 2020 to December 31, 2021.This statewide analysis of recent paramedic graduates suggests that an important gap between current education practices and the position of leaders in the EMS profession regarding degree requirements. With more than two-thirds of recent graduates not meeting requirements, the cost estimate to those students in NC would be nearly $2 million. Most currently certified paramedics in NC would not meet the position statements requirements for special certifications, potentially limiting their growth potential EMS. During the study period, there were 1,020 paramedic students that met inclusion criteria. Of those, 85.0% (868) had

complete level-of-education data available. Over two-thirds of these students would not currently meet the suggested initial educational requirements: 28% (242) who held a high school diploma or GED and 42% (363) who had some college credits but no degree. Thirty one percent would meet the suggested requirements: 13% with an associate degree and 18% (153) with a bachelor's degree or higher. The median age of those that would not have met the degree requirement was 25 years (IQR: 22 to 31 years). There were about equal numbers of males (48.3% [292]) and females. Over three-quarters (82.3% [498]) of those that would not have met degree requirements had race documented as White, 6.6% (40) were Latino(a), 5.8% (35) were Black, and 5.3% (32) had their race categorized as “other”.

78. **Price, C., Narloch, LB., Fernandez, AR., Nudell, N., Jacobson, KE., Blend, S., Gibbens, B., Eblen, J., Walth, H., Myers, JB., Crowe, RP. Defining a Suite of Performance Measures for Emergency Medical Services (EMS) in Rural Settings: North Dakota Rural EMS Counts Project. The annual meeting of the National Association of State EMS Officials. 2022. Charleston, South Carolina.**
The objective of this study was to define a suite of performance measures relevant to EMS organizations delivering care in rural areas through a systematic review and consensus building process conducted among panels of rural EMS subject matter experts. Through a systematic review of the literature, a modified Delphi approach, and measure development conference, 182 performance measures in 14 categories were defined for rural EMS: airway management, anaphylaxis, asthma/bronchoconstriction, cardiac, cardiac arrest, congestive heart failure/pulmonary edema, global, hypoglycemia, obstetrics/gynecology/neonate/pediatric, pain management, safety, seizures, stroke/transient ischemic attack (TIA), and trauma. For the implementation phase, the project steering committee prioritized five topic areas and selected measures for dissemination via the North Dakota state data platform. The five topic areas were: Cardiac, Stroke, Pain, Vital Sign Assessment, and Safety. All EMS agencies in the state were provided point and click access to all measures within these categories via the ND State EMS Data Repository. Benchmarking at the state and national level was also provided. Further, a baseline index document was created and freely distributed to describe current performance at the state and national levels. This index document further included insights and best practices for improving performance on these key measures. Via the project website, EMS agencies in the state also have access to toolkits for quality improvement to help develop systems of care, workflows and standard operating procedures. Agencies who choose to participate in quality projects related to these prioritized measures are also assigned a subject matter expert to guide improvement efforts.

79. **Lowery, B., D’Acunto, S., Crowe, RP., Fishe, JN. Using Natural Language Processing to Examine Social Determinants of Health in Prehospital Pediatric Encounters and Associations with EMS Transport. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to examine the presence of social determinants of health (SDOH) in EMS clinician free text notes, and quantify the association of SDOH with EMS pediatric transport decisions using natural language processing (NLP). All primary 9-1-1 responses for patients ages 0–17 years from the 2019 ESO Data Collaborative research dataset were included. NLP and an existing corpus were used to extract SDOH categories: income, food, housing, insurance, social support, self-isolation, and child services. We used chi-square tests to determine the univariate association between SDOH categories and transport. There were 325,847 pediatric EMS encounters, of which 35% (n=114,833) were nontransports. Child services (n=2,617) was the most common SDOH factor found in EMS narratives, followed by housing insecurity (1,136). Within the category of self-isolation, self-harm was present in 10,541 narratives. In the multivariable model, child services involvement (OR 2.55 [90% CI 2.29–2.85]), housing insecurity (OR 1.69 [90% CI 1.45–1.98]), insurance security (OR 2.68 [90% CI 2.09–3.44]), poor social support (OR 8.61 [90% CI 1.12–65.09]), and self-harm (OR 4.76 [90% CI 4.41–5.13])

were associated with greater odds of EMS transport. There was no significant association with food insecurity (OR 1.08 [90% CI 0.87–1.36]), or income insecurity (OR 1.42 [90% CI 0.92–2.17]).

80. **Crowe, RP., Kennel, J., Fernandez, AR., Bourn, SS., Burton, B., Van Vleet, L., Wang, HE., Myers, JB. Disparities in Prehospital Analgesia Administration for Trauma Patients With Long Bone Fractures. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to describe prehospital analgesia administration for trauma patients with long bone fractures and identify any differences by patient or encounter characteristics. The 2019 ESO Data Collaborative research dataset was used for this analysis. All adult patients transported by EMS who had an initial prehospital Glasgow Coma Scale score of 15 or AVPU of "alert" and hospital ICD-10 diagnosis codes indicating one or more long bone fractures were included. Encounters from non-paramedic level agencies were excluded. There were 15,150 patients with long bone fractures. Median age was 71 years and 64.5% were female. At least one prehospital pain scale (0–10) was documented for 84.9% (12,855) of patients and the median first pain score was 8 (IQR: 4–10). Prehospital analgesia was administered to 45.4% (6,882) of patients overall. In the adjusted model, Black or African-American patients were 40% less likely to receive analgesia compared to White patients (OR: 0.60, 95% CI: 0.50–0.72). Male patients were 33% less likely to receive prehospital analgesia compared to females (OR: 0.67, 95% CI: 0.60–0.75). For each 10-min increase in EMS transport time, odds of prehospital analgesia increased by 40% (OR: 1.40, 95% CI: 1.32–1.49).

81. **Jones, E., Sergot, P., Crowe, RP., Huebinger, R. Association Between Ketamine Dosing and Outcomes for Patients with Traumatic Injuries. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to evaluate the association between ketamine dosing and adverse outcomes for trauma patients in the prehospital setting. The 2018 and 2019 ESO Data Collaborative research datasets were analyzed. All adult 9-1-1 trauma patients with initial Glasgow Coma Scale (GCS) scores > 8 who received ketamine were included. Of 939 included trauma patients, 72% (675) received guideline dosing (median highest dose: 1.9 mg/kg, interquartile range [IQR]: 1.2–3.8 mg/kg) and 264 received above-guideline dosing (median highest dose: 2.6 mg/kg, IQR: 2.2–5 mg/kg). Above guideline sedation dosing was not associated with greater airway intervention.

82. **Goyal, A., Frawley, J., Chen, N., Gappy, R., Crowe, RP., Swor, R. Prehospital Use of Ketamine Among Pediatric Patients. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to describe patient and encounter characteristics among pediatric emergency medical services (EMS) patients who received ketamine. A secondary objective was to assess effectiveness of ketamine for reducing pain scores among injured patients. The 2019 and 2020 ESO Data Collaborative research datasets were used for this analysis. All 9-1-1 transports of pediatric patients (<18 years of age) who received ketamine were included. In 2019–2020, 1,291 of 422,968 ground-ambulance pediatric patients received ketamine. They were predominately male (842, 65.2%), teenaged (median age 16 years, IQR: 13–17), Caucasian (810, 62.7%), and from urban areas (1041, 80.6%). The most common EMS impressions were related to injuries (810, 62.7%) and behavior disorders (281, 21.8%). Only 980/1291 (75.9%) patients had weight recorded. Most patients (960, 74.4%) received single doses of ketamine, with EMS clinicians reporting improvement in 855 (66.2%). Among nonbehavior patients, 727/1010 (72.0%) had pain scores recorded. Pain scores decreased significantly from mean (SD) 7.0 (3.8) to 3.6 (3.4) ($p < 0.001$). No prehospital deaths were documented.

83. **Owusu-Ansah, S., Crowe, RP., Ramgopal, S. Characteristics and Management of Pediatric Prehospital Asthma. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**

The study objective was to describe prehospital treatment of asthma in general for children and to describe whether prehospital treatment of asthma varies by characteristics. The 2019 ESO Data Collaborative research dataset was used for this analysis. All patients 2 to 17 years old with primary complaints of asthma exacerbation were included. Patients with missing documented age, cardiac arrest, nontransports, scene assists, medical category of allergy and anaphylaxis, acute sinusitis, and asphyxiation were excluded. The primary outcomes of interest were prehospital interventions for pediatric asthma management. In total, 6,833 EMS encounters of pediatric patients with suspected asthma or wheezing were included. Bronchodilators were used in 75% of EMS encounters, with 11% of encounters receiving a bronchodilator prior to EMS arrival. Steroids were administered to 3.3%. Steroids were administered to 3.3%. Compared to White patients, bronchodilator use was increased for Black patients (OR:1.88, 95% CI: 1.55–2.29). Increased odds of bronchodilator use were also noted in the older patients (12–17 yr) relative to younger patients (2–5 yr; (OR:1.71, 95% CI: 1.37–2.14).

84. **Partain, AT., Pack, CE., Miller, ML., Crowe, RP., Brown, LH. 9-1-1 Transport Destination Decisions: Is Patient Choice a Safe Choice? The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**

The study objective was to determine if patient choice destinations require greater travel distances and transport times. The 2020 ESO Data Collaborative research dataset was used to identify 9-1-1 scene responses resulting in ground ambulance transport with a reason for destination decision documented. Of the 2,546,928 records included in the analysis, 1,194,979 (48%) listed closest hospital, 1,058,490 (42%) listed patient choice, and 249,662 (10%) cited a specialty facility as the reason for destination decision. Median (interquartile range [IQR]) transport distances were shorter for closest facilities than for patient choice or specialty facilities (3.9 (2.1–7.3) miles vs. 6.0 (3.2–11.5) miles vs. 6.2 (3.1–13.1) miles, respectively, $p < 0.001$). Similar results were seen for median (IQR) transport times: 10 (6–15) min vs. 14 (9–21) min vs. 15 (9–24) min, respectively ($p < 0.001$). Differences between closest and patient choice destinations were more pronounced in nonurban areas (4.3 (2.0–11.7) vs. 16.4 (5.6–27.3) miles; 10 (6–19) vs. 21 (10–33) min, $p < 0.001$). Importantly, patient acuity also differed across the three groups, with lights and sirens rates of 19.2%, 13.4%, and 28.8%, respectively ($p < 0.001$).

85. **Johnson, RC., Crowe, RP., Taigman, M., Jarvis, J., Petrites, S., Hern, G. Racial/Ethnic Disparities in EMS Stroke Assessment and Impressions Among Patients Diagnosed with Stroke. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**

The study objective was to compare emergency medical services (EMS) stroke assessment and impressions by patient race/ethnicity. The 2019 ESO Data Collaborative research dataset was used for this analysis. All patients with ED ICD-10 stroke codes were included. Patients who were unresponsive during the EMS encounter (AVPU < V or GCS < 14) were excluded. EMS clinician impressions of stroke or a documented stroke screen were used to define the outcome measure of EMS stroke recognition. There were 9,572 EMS patients with ED stroke diagnoses. More Hispanic patients (26%) had intracranial hemorrhages compared to White (18%) or Black (14%) patients. EMS documented a stroke impression or screen for 58% of White patients, 56% of Black patients, and 48% of Hispanic patients. After adjustment, compared to White patients, the odds of EMS stroke recognition were 19% lower in Black patients (aOR: 0.81, 95% CI: 0.72–0.91) and 32% lower in Hispanic patients (aOR: 0.68, 95% CI: 0.57–0.80).

86. **Frawley, J., Goyal, A., Gappy, R., Chen, N., Crowe, RP., Swor, R. A Comparison of Prehospital Pediatric Analgesic Use of Ketamine and Opioids. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to compare pain control, airway interventions, and mortality for ketamine compared to opioids when used for analgesia among pediatric patients. The 2019 and 2020 ESO Data Collaborative research datasets were used for this analysis. All pediatric patients (<18 years of age) who received ketamine or opioids were included. Patients receiving both medications and those with EMS clinical impressions indicating behavioral disorders were excluded. Primary outcomes of interest were pain score reduction and clinician-documented improvements. Of 422,968 pediatric 9-1-1 patients, 712 (4.7%) received ketamine and 14,552 (95.3%) received an opioid. Average age in both groups was 14 years. Patients who received ketamine were less likely to be injured (73.7% vs. 89.4%, $p < 0.001$). Both ketamine and opioid groups had high rates of improvement following first medication dose (85.3% vs. 87.1%, respectively). Reduction in pain scores for patients receiving ketamine versus opioids. were similar (mean, SD) -3.2 (3.6) vs. -3.1 (2.8), $p = 0.29$, respectively. There was a higher rate of ventilatory support (19, 3.0% vs. 11, 0.3%, OR: 41.5, 95% CI:19.6–87.5) in the ketamine group. Advanced airways were more commonly placed in patients who received ketamine compared to opioids, 89 (12.5%) versus 45 (0.3%) (OR: 46.1, 95% CI: 31.9–66.5). EMS narrative review of all cases involving advanced airway placement for both medications revealed 133/134 clear mentions of intentional RSI due to severe illness or injury. There were no deaths in the ketamine group and three deaths (0.02%) in the opioid group.

87. **Farcas, A., Crowe, RP., Gomez, S., Donofrio-Odman, JJ. A Multiagency Comparison of EMS Resuscitation Practices for Pediatric Versus Adult Patients in Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to compare prehospital resuscitation practices and outcomes for pediatric and adult patients with nonshockable out-of-hospital cardiac arrest (OHCA). The 2019 ESO Data Collaborative research dataset was used to this analysis. Only cases where cardiac arrest occurred before EMS arrival, resuscitation was attempted, and the initial rhythm was pulseless electrical activity or asystole were included. Traumatic arrests and responses by basic life support (BLS)-only agencies were excluded. There were 834 pediatric and 5,111 adult OHCA patients analyzed in this study; 91.5% of pediatric patients were transported, compared to 60.1% of adults ($p < 0.01$), with median scene intervals 12.3 (IQR: 6.0–20.0) and 22.5 (IQR: 16.6–30.0) min, respectively ($p < 0.01$). ROSC was achieved in 14.4% of pediatric versus 24.4% of adult patients ($p < 0.01$). Of adult patients, 89.6% received epinephrine, and 5.6% of first epinephrine administrations occurred during transport. Likelihood of receiving epinephrine decreased with younger pediatric age categories (83.7% teens to 51.5% neonates, p-trend < 0.01), while likelihood of first epinephrine during transport increased (38.1% neonates to 9.4% teens, p-trend < 0.01). Univariable odds of ROSC were lower for pediatric (OR: 0.24, 95% CI 0.12–0.49) and adult patients (OR: 0.38, 95% CI 0.26–0.57) when first epinephrine was given in transport versus on scene.

88. **Pack, CE., Partain, AT., Crowe, RP., Brown, LH. Are There Disparities in the Transport Destinations for White and Non-White Patients attended by Emergency Medical Services? The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA**
The study objective was to compare destinations for a broader sample of White and non-White emergency medical services (EMS) patients transported from scenes within the same ZIP code. The 2020 ESO Data Collaborative research dataset was used for this analysis. All 9-1-1 scene responses resulting in ground transport were included. A masked scene ZIP code variable was used to preserve deidentification. Among 2,914,889 eligible transports from 2,730 ZIP codes, 69.9% (CI: 69.8%–70.0%) of White patients and 62.4% (CI: 62.3%–62.5%) of non-White patients were transported to reference destinations. There are statistically significant and practically

meaningful differences in the destination hospitals for White and non-White patients transported by EMS from within the same ZIP code. In the multivariable analysis, White patients remained more likely to be transported to reference destinations than non-Whites (odds ratio 1.22, CI: 1.22–1.23). At the individual ZIP code level, 1,332/2,730 (48.8%, CI: 46.9%–50.7%) ZIP codes had a 5% or greater difference in the proportion of Whites and non-Whites transported to the reference destination; 26.1% (CI: 24.5%–27.8%) of ZIP codes had a 10% or greater difference.

89. **MacAllister, S., Crowe, RP., Smith, M., Fernandez, AR., Bourn, SS., Myers, JB. Prehospital Recognition of Sepsis by EMS Clinicians is Associated with Reduced Patient Mortality. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to describe EMS sepsis recognition and its association with patient mortality. The 2019 ESO Data Collaborative research dataset was used for this analysis. All 9-1-1 records for adult patients (>17 years) with ED ICD-10 diagnosis codes indicating sepsis were included. EMS sepsis recognition was defined as an EMS impression indicating sepsis, use of an EHR sepsis assessment form, or a documented sepsis alert. There were 21,220 patients with any ED sepsis diagnosis attended by 221 EMS agencies. Median age was 71 (IQR: 61–81) years and 50.9% (10,749) were female. EMS recognized 21.5% (4,552) of cases. Fewer than one in four EMS patients with sepsis were identified as such in the prehospital documentation. Among 3,763 patients with septic shock, EMS recognized 23.6% (888). While more EMS-recognized patients presented with abnormal vital signs, prehospital recognition was associated with reduced patient mortality.

90. **Guterman, EL., Burke, JF., Newman, TB., Crowe, RP., Lowenstein, DH., Sporer, KA. Underdosing and Effectiveness of Prehospital Benzodiazepine Treatment for Status Epilepticus. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to examine national prehospital benzodiazepine treatment and the association between midazolam dose, seizure termination, and respiratory failure. The 2019 ESO Data Collaborative research dataset was used for this analysis. All adults with status epilepticus treated with midazolam, lorazepam, or diazepam were included. Patients with cardiac arrest were excluded. There were 9,176 encounters from 743 agencies where midazolam (83.6%), lorazepam (13.8%), or diazepam (2.7%) was administered. Mean age was 46 years (SD 18) and 49.5% (4,526) were female. Initial treatment was discordant with guidelines in 96.1% (8,819 discordant dose or route: 8,562 discordant dose, 5,415 discordant route), and 83.3% (619) of agencies never administered guideline-concordant treatment. For encounters involving midazolam, median intravenous dose was 3 mg (IQR: 2–5; 3,481 encounters), median intramuscular dose was 5 mg (IQR: 5–5; 2,642 encounters), and median intranasal dose was 5 mg (IQR: 3–5; 1,505 encounters). Between-agency variability accounted for 47% of variance in dosing. Rescue therapy was given in 29.4% (2,028) of encounters and ventilatory support in 6.1% (429). Among those receiving midazolam, receiving >5 mg was associated with 8.5% (95% CI 4.9% to 12.0%) absolute decreased risk of rescue therapy and a nonsignificant 0.6% (95% CI 0.7% to 1.9%) risk of ventilatory support. Instrumental variable analyses yielded similar results.

91. **Niederberger, SM., Crowe, RP., Salcido, DD., Menegazzi, JJ. Sodium Bicarbonate Use in EMS-Treated Out-of-Hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to analyze the association of bicarb with resuscitation outcomes in nontraumatic Out-of-Hospital Cardiac Arrest (OHCA). The 2019 and 2020 ESO Data Collaborative research datasets were used for this analysis. All adult patients experiencing cardiac arrest prior to emergency medical services (EMS) arrival in nonhospital settings with resuscitation attempted were included. The analysis was restricted to cases with resuscitation lengths between 5 and 40

min. Prehospital return of spontaneous circulation (ROSC) and survival to hospital discharge were compared by bicarb use status. In total, 51,916 OHCA records were reviewed, of which 47,346 (91.2%) occurred prior to EMS arrival. Of these, 9,503 (20.1%) had shockable initial rhythms, 8,436 (19.4%) had ROSC, and 2,701 (5.7%) survived to discharge. Overall, 15,627 (33.0%) received bicarb, with 2,940 (30.9%) in the shockable and 12,687 (33.5%) in the nonshockable groups ($p < 0.001$). Overall, bicarb administration during shockable OHCA was inversely associated with survival, but was associated with improved survival and ROSC in asystole.

92. **Fernandez, AR., Crowe, RP., Bourn, SS., Myers, JB. National Description of EMS Back-in-Service Time from 2019-2021. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to describe changes in EMS back-in-service intervals from 2019–2021. The ESO Data Collaborative records from 2019–2021 were used in this analysis. Data for 2021 were limited to the first 6 months. Therefore, the study period was limited to the first 6 months of 2019 and 2020 for comparison. All 9-1-1 responses that resulted in patient transport were included. Only EMS agencies with data in the ESO Data Collaborative for all 3 years were included. Over the first 6 months of each year there was a total of 5,904,149 (2019: 2,325,424; 2020: 1,704,247; 2021: 1,876,089) emergency responses among 1,112 agencies. The median back-in-service interval overall was 19.48 (interquartile range [IQR] 12.97–29.13) min. Median back-in-service interval in urban areas (20.08, IQR 13.57–29.55) was 3.08 min longer than in rural areas (17.00, IQR 11.00–27.00). From 2019 to 2021, median back-in-service interval increased by 1.18 min (2019: 18.82, IQR 12.07–28.35; 2020: 19.93, IQR 13.22–29.37; 2021: 20.00, IQR 13.38–29.93). Urban areas saw an increase of 1.35 min (2019: 19.40, IQR 13.22–29.37; 2020: 20.57, IQR 14.00–29.92; 2021: 20.75, IQR 14.07–30.42). Rural areas saw an increase of 0.30 min (2019: 16.70, IQR 10.37–28.00; 2020: 17.02, IQR 11.30–26.65; 2021: 17.00, IQR 11.40–26.73).

93. **Joiner, AP., Cabanas, JG., Crowe, RP., Fernandez, AR., Godfrey, A., Grover, J., Myers, JB., Van Vleet, L., Pavon, J. Differentiating between EMS-Transported and Nontransported Fall Patients: A National Description of Prehospital Falls. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to describe characteristics associated with nontransport among EMS patients encountered for falls. The 2019 ESO Data Collaborative research dataset was used for this analysis. All patients who had 9-1-1 encounters for ground-level falls and were ages 60 years or older were included. Patients residing in congregate living facilities, interfacility transports, cardiac arrests, and suspected drowning patients were excluded. There were 195,204 fall patients in 2019, including 27,563 (14.1%) nontransports. Most patients were female (63.3%), White (85.4%), and fell at home (80.4%). Greater odds of nontransport were identified among males (OR 1.36, 95% CI 1.31–1.41) and Hispanic–Latino patients (OR 1.20, 95% CI 1.11–1.30). Older age was associated with greater odds of nontransport compared to patients ages 60–69 years (70–79 [OR 1.40, 95% CI 1.33–1.47], 80–89 [OR 1.49, 95% CI 1.41–1.57], ≥90 [OR 1.45, 95% CI 1.35–1.54]). Patients residing in census tracts with larger percentages of the population living in poverty had lower odds of nontransport compared to those in areas with 25% poverty [OR 0.80, 95% CI 0.74–0.85]).

94. **Sergot, P., Jones, E., Crowe, RP., Huebinger, R. Ketamine Dosing and Association with Outcomes for Patients with Behavioral Emergencies. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to evaluate the effect of prehospital ketamine dosing on outcomes for patients with undifferentiated behavioral emergencies. The 2018 and 2019 ESO Data Collaborative research datasets were used for this analysis. All nontraumatic, adult behavioral

and drug-related 9-1-1 EMS encounters where ketamine was given were included. There were 3,271 patients included: 506 in the high dose group (median highest dose 3 mg/kg, IQR 1.8–4.4 mg/kg) and 2,072 in the low dose group (median dose 5 mg/kg, IQR 2.7–5.5 mg/kg). Compared to high dose, the low dose group median age was higher (36 vs. 33.5), fewer patients were White (66.6% vs. 70.1%), and initial median GCS was higher (13 vs. 11). Other characteristics were similar. Patients given ketamine doses above consensus guidelines recommendations for sedation were not more likely to experience worse outcomes.

95. **Lincoln, EW., Crowe, RP., Brown LH. Racial and Ethnic Disparities in Administration of Prehospital Analgesia for Patients with Nontraumatic Abdominal Pain. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to assess prehospital pain assessment and analgesia administration for patients with abdominal pain. The 2019 ESO Data Collaborative research dataset was used for this analysis. All 9-1-1 transports for adult patients (>17 years) with EMS primary impressions of abdominal pain were included. Patients who were pregnant, those with traumatic injuries, and those with initial GCS < 14 were excluded. Responses from basic life support (BLS)-only agencies were also excluded. There were 160,554 records from 1,049 agencies included in this analysis. The median age was 56 (IQR: 40–71) years and 59% were female. Most were White, non-Hispanic (64%), 26% were Black, non-Hispanic, and 8% were Hispanic. At least one pain score was documented in 80% of patients, with similar documentation rates across race/ethnicity categories. Median first pain score among White patients was 6 (IQR:4–9), Black was 8 (IQR:4–10), and Hispanic was 7 (IQR:4–10). Analgesia administration varied across race and ethnicity categories, with White patients receiving analgesia in 14% of cases, Black patients in 9% of cases, and Hispanic patients in 14.5% of cases. After adjustment, compared to White patients, Black patients were 39% less likely to receive pain medication (OR: 0.61, 95% CI: 0.57–0.65). Compared to White patients, there was no difference in analgesia administration in Hispanic patients (OR: 0.98, 95% CI: 0.89–1.07).

96. **Bourn, SS., Fernandez, AR., Crowe, RP., Myers, JB. Are Changes in the Prehospital Rapid Emergency Medicine Score During the EMS Encounter Associated with Changes in Hospital Outcomes. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to determine whether increases in REMS during the EMS encounter are associated with increased rates of hospital admission and overall mortality. The 2019 ESO Data Collaborative research dataset was used for this analysis. All adult patients with ED dispositions who had adequate data to calculate a first and last REMS were included. Patients with no change or decreases in REMS were compared to those with increases during the encounter using univariable odds ratios (OR) and 95% confidence intervals (95% CI). Primary outcomes were hospital admission and overall mortality. In total, 473,977 patients were included in the analysis. Most (67.1%, 317,968) had no change between initial and final REMS; 20.3% (96,398) had final REMS less than baseline; 12.6% (59,611) had final REMS greater than initial REMS. Odds of hospital admission were 1.4 times higher for patients whose REMS increased (OR 1.39, 95% CI 1.37–1.41) compared to those with no change or reduction. Mortality analysis was performed on 446,958 patients. Overall mortality for patients with stable/improved REMS was 1.3%, compared to 2.6% for patients with increasing REMS, resulting in an odds ratio of 2.01 (95% CI 1.91–2.13).

97. **Hanna, A., Crowe, RP., Fishe, JN. Pediatric Bradycardia is Undertreated in the Prehospital Setting: A Retrospective Multi-Agency Analysis. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to describe the incidence, characteristics, and emergency medical services (EMS) interventions for pediatric patients with bradycardia. The 2019 ESO Data

Collaborative research dataset was used for this analysis. All encounters for pediatric patients ages 0-18 were included. Bradycardia was defined as two consecutive EMS-recorded pulse rates that were bradycardic per the 2015 PALS guidelines. We excluded patients who initially presented in cardiac arrest and patients with initial heart rates < 10 as we presumed those to be cardiac arrests. There were 1,209 patients meeting bradycardia criteria. The median age was 2 years (IQR: 0–13), 58.5% of patients were male, 51.1% White, and 28.8% Black. Most (93.6%) responding crews were advanced life support (ALS) units. When considering PALS-recommended treatments, 73% of patients did not receive any oxygen, CPR, atropine, or epinephrine.

98. **Holdaway, JN., Crowe, RP., Bosson, N. Donofrio-Odmann, JJ. Sex and Racial/Ethnic Disparities in Prehospital Care for Patients with ED-Diagnosed STEMI. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to compare prehospital management of patients with emergency department (ED)-diagnosed ST-elevation myocardial infarctions (STEMI) by sex and race/ethnicity. The 2019 and 2020 ESO Data Collaborative research datasets were used for this analysis. All EMS records for patients aged ≥18 years with ED ICD-10 diagnosis of STEMI. Interfacility transfers, cardiac arrest, and non-advanced life support (non-ALS) transports were excluded. Primary outcome was 12-lead electrocardiograph (ECG) acquisition. Secondary outcomes included nitroglycerin administration, opioid analgesia, and age-adjusted mortality. There were 4,891 patients with ED STEMI diagnoses attended by 300 EMS agencies. More male patients (91.4%, 95% CI: 90.4–92.3%) had documented prehospital 12- lead ECGs compared to female patients (88.8%, 95% CI: 87.2–90.2%), p < 0.01. An interaction between race/ethnicity and sex was identified; Black female patients (86.6%, 95% CI: 81.7–90.4%) had the lowest rate of ECG acquisition compared to White male patients (91.9%, 95.0% CI: 90.7–93.0%), p < 0.05. Similar patterns were observed for opioid analgesia and nitroglycerin. Opioid analgesia was lowest among Black females (8.8%, 95% CI: 5.8–13.1%) compared to White males (20.3%, 95% CI:18.7–22.0%), p < 0.01. Nitroglycerin use was lowest in Hispanic females (34.0%, 95% CI: 25.3–44.0%) compared to White males (51.4%, 95% CI: 49.4–53.5%), p < 0.01. Age-adjusted mortality was higher in females (11.0%, 95% CI: 9.4–12.5%) compared to males (7.9%, 95% CI: 6.8–8.9%), p < 0.01.

99. **Niederberger, SM., Crowe, RP., Salcido, DD., Menegazzi, JJ. Sodium Bicarbonate Use in EMS-Witnessed Out-of-Hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to analyze bicarb administration with resuscitation outcomes in EMS-witnessed OHCA. The 2019 and 2020 ESO Data Collaborative research datasets were used for this analysis. All adult patients experiencing EMS-witnessed, nontraumatic cardiac arrest in nonhospital settings with resuscitation attempted were included. Prehospital return of spontaneous circulation (ROSC) and survival to hospital discharge were compared by bicarb use status. Of 51,916 EMS-treated OHCAs in the database, we identified 4,570 (8.8%) EMS-witnessed OHCAs. Of these, 680 (14.9%) had initial shockable rhythms, 857 (18.85%) had ROSC, and 354 (7.75%) survived to discharge. Overall, 133 (19.55%) in the shockable and 1,143 (29.38%) in the nonshockable group received bicarb (p < 0.001). Overall, bicarb administration during EMS-witnessed nontraumatic OHCA was independently associated with improved survival in shockable presenting rhythms, but was not associated with improved ROSC outcomes in either rhythm group.

100. **Mannion, B., Pirrallo, R., Dix, A., Estes, L. The Effect of Prehospital Blood Transfusion on Patient Body Temperature from Time of EMS Transfusion to Arrival at the Emergency Department. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**

The study objective was to compare body temperature before and after transfusion of prehospital blood products. Two sources were used for data acquisition: ESO (ESO, Austin, TX) for all prehospital data, and Epic (Epic Systems Corp., Verona, WI) for all ED and inpatient data. Body temperature was obtained upon initial emergency medical services (EMS) evaluation by oral or cutaneous route, and in the ED by oral or rectal route. Two sources were used for data acquisition: ESO (ESO, Austin, TX) for all prehospital data, and Epic (Epic Systems Corp., Verona, WI) for all ED and inpatient data. Body temperature was obtained upon initial emergency medical services (EMS) evaluation by oral or cutaneous route, and in the ED by oral or rectal route. Forty-nine consecutive patients were analyzed: 31 males and 18 females; mean age was 57 years. Reason for transfusion included 13 traumatic hemorrhages and 36 medical indications, with gastrointestinal (GI) bleed being most common (43%). Most patients (80%) received 2 units pRBC (maximum 4 units); 59% of patients also received FFP. Initial EMS pretransfusion body temperatures were compared with initial ED temperatures. A paired, two-tailed t-test demonstrated a statistically significant difference in body temperature pre transfusion and upon ED assessment (t=2.806, p=0.007). Although a statistically significant difference in body temperature following blood transfusion occurred in this cohort, there was found to be a clinically insignificant difference between the means of these two groups (0.8°F).

101. **Miller, ML., Partain, AT., Watanabe, BL., Crowe, RP., Brown, LH. Heterogeneity Among Patients with Behavioral Emergencies Requiring Emergent Sedation. The annual meeting of the National Association of Emergency Medical Service Physicians. 2022. San Diego, CA.**
The study objective was to determine if demographics, clinical presentations, and hospital diagnoses differed across three types of behavioral-related presentations. The 2019 ESO Data Collaborative research dataset was used for this analysis. All paramedic-attended 9-1-1 scene responses to patients with behavioral manifestations, combativeness (from uncooperativeness to frank violence), or a combination of both, who required emergent sedation were included. Patients with conditions that potentially mimic behavioral emergencies (e.g., hypoglycemia, head injury) were excluded. Of 8,360 patients receiving emergent sedation, 2,003 (24%) presented with behavioral manifestations alone, 1,638 (20%) with combativeness alone, and 4,719 (56%) with both. Patients with combativeness alone were more likely than patients with behavioral manifestations alone or a combination of the two to be male (73% [CI: 71–75%] vs. 56% [CI: 55–58%]), be injured (20% [CI: 18–22%] vs. 14% [CI: 13–15%]), or have altered mental status (16% [CI: 14–18%] vs. 6% [CI: 6–7%]). Patients with behavioral manifestations alone were more likely than those with any combativeness to be tachypneic (27% [CI: 25–29%] vs. 19% [CI: 18–20%]), tachycardic (37% [35–39%] vs. 26% [CI: 25–27%]), or hypertensive (9% [CI: 8–11%] vs. 6% [CI: 5–6%]. Diagnosis data were available for 2,220 (27%) patients. A mental health diagnosis was less likely among patients presenting with combativeness alone (64% [CI: 60–69%]) compared with specific behavioral manifestations alone (77% [CI: 73–80%)) or a combination of both (74%, [CI: 71–76%])

102. **Gage, C., Deziel, JD., Wilfong, JA., Sensitivity and Specificity of Emergency Medical Dispatching Protocols in the United States. Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2021. Atlanta, GA**
The study objective was to evaluate the sensitivity and specificity of emergency medical dispatch (EMD) protocols in the United States. The 2019 ESO Data Collaborative research dataset was analyzed to determine the sensitivity and specificity of multiple variables when the ambulance was dispatched with lights/sirens compared to no lights/sirens. The results showed that 87% of all 9-1-1 calls were dispatched with an ambulance using lights/sirens when traveling to the patient, and 86% of the patients transported were transported with no lights/sirens. When comparing the use of lights/sirens upon dispatch to their use during transport, EMDs had a positive predictive value of 15.61% and a negative predictive value of 97.86%. The lights/sirens

transport results suggest patients are generally sicker than those without lights/sirens transports.

103. **Fernandez, AR., Crowe, RP., Bourn, S., Myers, B. Minimum Vital Sign Set Documentation Among 9-1-1 Patients Not Transported By EMS. Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2021. Atlanta, GA**
The study objective was to describe documentation of a minimum set of vital signs and associated factors among 9-1-1 events in which the patient was not transported by EMS. Data were obtained from the ESO Data Collaborative for calendar year 2020. All 9-1-1 responses for adults (age ≥18 years) not transported by EMS were included. Nontransports were excluded if the EMS disposition indicated the patient refused evaluation or treatment. A minimum set of vital signs was defined as documentation of heart rate, respiratory rate, and systolic blood pressure. Of 8,296,774 total 9-1-1 events, 11.6% (980,199) involved adult patients not transported by EMS. A minimum set of vital signs was documented for 77.0% (754,787). Compared to patients ages 18–30 years, patients in every other decade of life had increased odds of minimum vital sign set documentation. Odds were decreased for males (OR=0.88; 95% CI: 0.88–0.89). Compared to patients with race/ethnicity categorized as white, Black patients (OR =1.58; 95% CI: 1.56–1.60), Hispanic patients (OR=1.17; 95% CI: 1.14–1.19), and patients categorized as other (OR=1.20; 95% CI: 1.15–1.25) had increased odds. EMS encounters in rural areas saw a 44% reduction in the odds of minimum vital sign set documentation (OR=0.56; 95% CI: 0.55–0.56).

104. **Fernandez, AR., Crowe, RP., Bourn, S., Myers, B. Evaluating Prehospital Use of Personal Protective Equipment During the COVID-19 Pandemic. Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2020 and The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to describe the use and reuse of PPE among EMS providers during the COVID-19 pandemic. All 9-1-1 records from the national ESO Data Collaborative from March 5–June 15, 2020 with a documented EMS provider primary or secondary impression indicating COVID-19 were included. PPE was considered to have been used during the encounter if any of the above-mentioned PPE articles were documented for at least one EMS provider listed on the prehospital care record. There were 34,984 records with a COVID-19 impression documented. Of those, 15% (5,263) did not have PPE documented. Among the 29,721 records with documented PPE, a mask (N95, surgical mask, or PAPR) was documented on 89% (26,529) of records. Of those, 82% (24,469) had documented N95 use, of which 42% (10,290) indicated reuse. Another 17% (5,261) recorded use of surgical masks, of which 42% (2,220) indicated reuse. PAPR use was documented on 3% (967) of records. Face shield use was documented on 19% of records (5,537), of which 37% (2,027) indicated reuse. Finally, eye protection was documented on 88% (26,175) of records with documented PPE.

105. **Harris, M; Fishe, J; Crowe, R; D'Acunto, S; Adelgais, K; Anders, J. Applying a Set of Termination of Resuscitation Criteria to Pediatric Out-of-hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to apply a set of pediatric Termination of Resuscitation (pTOR) criteria in a large national cohort and examine the test characteristics associated with its accuracy in predicting return of spontaneous circulation (ROSC) after pediatric out of hospital cardiac arrest (POHCA). Data were obtained from the ESO Data Collaborative from January 1, 2019 to December 31, 2019. Patients ages 0-18 treated by EMS with cardiac arrest were included. Those suffering from traumatic cardiac arrest were excluded. The Maryland criteria allows for consideration of pTOR after medical POHCA for patients 0-17 years with asystole after 30 minutes of resuscitative efforts on scene, the administration of epinephrine, and an end-tidal CO2<15 mmHg. A total of 1,762 patients were evaluated, with 1,475 meeting inclusion criteria.

The Maryland pTOR rule was highly specific (99% specificity, 4% sensitivity , Positive Predictive Value 96%, and Negative Predictive Value 24%), although 2 patients who achieved ROSC would have met the criteria for termination of resuscitation.

106. **Rodriguez, E; Baade, H; Crowe, R; Myers, B; Wampler, D. Measuring the Overuse of Helicopter Air Ambulances for Transport of Trauma Patients. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to measure the over-triage rate in Helicopter air ambulance (HAA) use for trauma transport. All 9-1-1 records from the national ESO Data Collaborative from January 1, 2018 to December 31, 2018 were included. Major trauma activation criteria were defined using available discrete data elements: systolic blood pressure<90 mmHg; respiratory rate<10 or>29; GCS<14; penetrating wound to head, neck, or torso; amputation; or pelvis injury. The validated Rapid Emergency Medicine Score (REMS) was used to evaluate baseline prehospital patient acuity. There were 691,901 trauma responses in the study period and 1% (5,984) were transported by HAA. No major trauma activation criteria were documented for 57% (3,448) of HAA patients. The median initial prehospital REMS score for patients transported by HAA without documented trauma activation criteria was 3 (IQR: 2-6) compared to 7 (IQR: 4-10) among HAA patients with at least one criterion (p<0.001). -in-3 HAA transports without activation criteria originated in urban settings, suggesting time savings may have been limited.

107. **Crowe, RP., Bourn, S., Fernandez, AR., Myers, B. Initial Prehospital Rapid Emergency Medicine Score to Predict Emergency Department and Hospital Dispositions of EMS Patients. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to assess predictive characteristics of initial prehospital Rapid Emergency Medicine Score (REMS) for ED and hospital dispositions. This retrospective analysis used linked prehospital and Health Data Exchange data from the ESO Data Collaborative from January 1, 2019 to December 31, 2019. Initial REMS (0-26) was calculated using age, pulse rate, mean arterial pressure, respiratory rate, oxygen saturation, and Glasgow Coma Scale. Patients<18 and cardiac arrests prior to EMS arrival were excluded. Overall, 62%(n=304,234) of patients were discharged from the ED, 36% (n=178,600) were admit-ted, 2% (n=10,697) were transferred, and 0.2% (n=960) died in the ED. Median REMS of discharged patients was 5 compared to 7 among admissions and 11 among patients who died in the ED (p<0.01). A REMS cut-point of >5 demonstrated optimal statistical prediction for admission or ED mortality (AUROC:0.69). REMS>5 demonstrated a three-fold increase in odds of admission or ED mortality (OR: 3.28, 95%CI: 3.24-3.32). Median REMS for discharged patients was 7 and 9 for patients who died. Among admitted patients, initial prehospital REMS>5 was associated with a 3-fold increase in odds of hospital mortality (OR:3.02, 95%CI:2.81-3.24).

108. **Crowe, R; Pepe, P; Fernandez, AR; Bourn, S; Manifold, C; Myers, B. Comparison of Benzodiazepines, Ketamine and Antipsychotics for Prehospital Sedation of Patients Experiencing Behavioral Health Emergencies with Combativeness. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to compare the relative safety of benzodiazepines, ketamine and antipsychotics among patients experiencing out-of-hospital behavioral emergencies with combativeness (BHE-C) using a large nationwide database. A retrospective 2019 calendar year analysis of BHE-C records from the ESO Data Collaborative was performed including subsets of records with linked Health Data Exchange emergency department (ED) and hospital outcomes. BHE-C patients were identified by EMS impression and/or documented signs/symptoms. Prehospital sedation was defined as intramuscular or intranasal administration of a benzodiazepine, ketamine, or an antipsychotic as the first medication provided. Outcomes included prehospital noninvasive positive pressure ventilation (NIPPV), advanced airway

placement, and ED/hospital disposition. Fewer than 1 in 5 patients experiencing BHE-C received prehospital sedation and benzodiazepines were used most frequently. Ketamine was associated with more ventilation and advanced airway assistance, but no differences were observed with regard to in-hospital deaths and no deaths occurred in the prehospital or ED settings.

109. **Walter, D; Chan, HK; Crowe, R; Osborn, L; Jarvis, J; Wang, H. Effect of Prehospital Noninvasive Positive Pressure Ventilation for Rescue of Acute Dyspnea. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to characterize the association of out-of-hospital noninvasive positive pressure ventilation (NIPPV) with improvement of dyspnea in a national EMS cohort. Data were obtained from the ESO Data Collaborative from January to December 2018. Acute dyspnea was defined as adults (age≥18 years) with initial respiratory rate (RR) ≥30 breaths/minute (bpm) and EMS clinical impression of respiratory emergency. The primary outcome was change in RR, censored at 90 minutes of treatment. Of the 5,172,504 adult 911 responses, 33,585 were included with acute dyspnea, including 8,750 (26.1%) NIPPV and 24,835 (73.9%) non-NIPPV. In this multicenter series of out-of-hospital acute dyspnea, NIPPV was not associated with improved RR. Median treatment durations were: NIPPV 23.3min (IQR 16.5-32.1), non-NIPPV 23.6 min (IQR 16.3-32.8).

110. **Huebinger,R; Stilgenbauer, H; Jarvis, J; Ostermayer, D; Schulz, K; Wang, H. Video Laryngoscopy for Out-of-Hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to evaluate the association between video laryngoscopy (VL) with first pass success and ROSC. This study used the data from January 1, 2018 to December 31, 2018 obtained from the ESO Data Collaborative. All patients ≥18 years of age were included. Compared to direct laryngoscopy (DL), VL had a lower rate of bystander CPR (41.4% v 36.1%, p<.001), but other characteristics were similar between the groups. VL had a higher first pass success rate than DL (75.1% v 69.5%, p<.001). Using a mixed model analysis, VL was associated with a higher rate of first pass success (OR 1.5, CI 1.3-1.6), but VL was not associated with improvement in ROSC (OR 1.1, CI 0.97-1.2) or sustained ROSC (OR 1.1, CI 0.9-1.2).

111. **Dean, B; Crowe, R; Fernandez, AR; Bourn, S; Myers, B. Initial Prehospital Glasgow Coma Scale and its Components to Predict Mortality among Trauma Patients. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to assess predictive performance of initial prehospital GCS and its components for mortality among trauma patients. This was a retrospective analysis of 911 records for adult trauma patients from 1/1/2019-12/31/2019 and hospital disposition within the ESO Data Collaborative. Patients with penetrating trauma were excluded. Receiver operating curves for total GCS, the eye component (GCSe), verbal component (GCSv) and motor component (GCSm) were constructed and area under these curves (AUROC) was measured to compare predictive values of the GCS and its components for mortality. AUROC for total GCS was 0.74 (95%CI: 0.72-0.76), 0.67 (0.65-0.69) for GCSe, 0.73 (0.72-0.75) for GCSv and0.69 (0.67-0.70) for GCSm. Initial prehospital GCSm and GCSe components demonstrated similar predictive characteristics for mortality compared to total GCS. The use of these two simplified components of the GCS may be a prehospital tool to identify patients with increased mortality risk.

112. **Ashburn, N; Snavely, A; Scheidler, J; Angi, R; Crowe, R; McGinnis, H; Hiestand, B; Miller, C; Mahler, S; Stopyra, J. Disparities in Emergency Medical Services Times for Rural Patients with Acute Cardiac Complaints. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**

The study objective was to quantify rural and urban differences in EMS time intervals for patients with cardiac problems. The ESO Data Collaborative was queried for 911 calls with an impression or chief complaint of a cardiac problem among adults(age≥18) from 1/1/2013-6/1/2018. The primary outcome was total prehospital time, defined as dispatch to hospital arrival. Secondary outcomes included response time (dispatch to scene arrival), scene time (scene arrival to depart scene), and transport time (depart scene to hospital arrival). The median total prehospital, response, scene, and trans-port times were 36 (IQR 28-47), 5 (IQR 3-9),16 (IQR 12-21), and 13 (IQR 8-20) minutes, respectively. After adjusting for age, sex, race, response priority, and stability, the total prehospital time on average was 16.22 (95%CI 14.61-17.82) minutes longer for rural patients than urban patients. Similarly, on average response time was 5.32 (95%CI 4.76-5.87) minutes longer, scene time 0.45 (95%CI0.22-0.69) minutes longer, and transport time10.57 (95%CI 9.34-11.79) minutes longer for rural patients.

113. **Miller, M; Watanabe, B; Brown, L. Are there gender or racial disparities in EMS-administered sedation among patients in police custody? The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to explore whether racial disparities exist in the frequency of EMS-administered sedation for patients in police custody. This study used the data from January 1, 2018 to December 31, 2018 obtained from the ESO Data Collaborative. Inclusion criteria were: (1) EMS requested by police; (2) response by a paramedic level agency; and (3) scene, transport or disposition data suggesting the patient was in custody or otherwise under police control. Additionally, sedation in the subset of patients with a chief complaint, primary impression, secondary impression, treatment protocol, or barrier to care entry presumptively suggesting the patient was combative were explored. Sedation was defined as documented administration of ketamine, lorazepam, midazolam, propofol, haloperidol or droperidol. There were 50,542 law enforcement requests for EMS response for in-custody patients that were attended by a paramedic level agency. There were 532 (1.1%) instances of sedation. The proportion of in-custody males and females who received sedation was similar, (1.2% vs.1.0%, p=0.116), as were the proportions of White (1.2%), Black (1.1%) and Hispanic (1.0%) patients (p=0.330). There were 11,007 (22%) responses involving presumptively combative patients, with 289 (2.6%) receiving sedation. The lack of association between race/ethnicity and sedation persisted in the subset of combative patients (p¼0.779), but combative male patients were more likely than combative female patients to receive sedation (3.1% vs. 1.8%, p<0.001).

114. **Miller, M; Watanabe, B; Robinson, E; Brown, L. Evaluating the Efficacy and Safety of Ketamine Administration for Prehospital Pain Control. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to explore the efficacy and safety of ketamine, in comparison with morphine and fentanyl, when used solely for analgesia in isolated, non-cardiorespiratory painful conditions. This study used the data from January 1, 2018 to December 31, 2018 obtained from the ESO Data Collaborative. Inclusion criteria were: a 911 scene response; age≥18 years; an initial complaint or use of a treatment protocol indicating a painful condition; prehospital administration of ketamine, fentanyl or morphine; and first and last pain scale and GCS data available. Patients were excluded if they received a combination of medications, or if there were indications medication administration could have been for airway management or agitation control. In pairwise comparisons, all three groups differed from each other (all p<0.001). Most patients had no change in GCS, but ketamine more often reduced GCS by 2 or more points (n=100, 9.5%) than fentanyl (n=112, 0.2%) or morphine (n=19, 0.2%), and the distributions of GCS changes differed across the three groups (p<0.001). In pairwise comparisons, ketamine decreased GCS more than fentanyl (p<0.001) and morphine (p<0.001); GCS changes did not differ for the morphine and fentanyl groups (p=0.721).

115. **Fernandez, AR; Crowe, R; Bourn, S; Myers, B. National Description of Prehospital Ketamine Administration including Patient Outcomes.**
The study objective was to describe prehospital ketamine administration and patient outcomes using a large national database. This retrospective observational study included all 9-1-1 responses, from the national ESO Data Collaborative, with prehospital ketamine administration for all patients, except cardiac arrest prior to EMS arrival, from 1/1/2019 to 12/31/2019. Hospital outcomes were obtained from ESO Health Data Exchange data. There were 15,204 prehospital ketamine administrations among 11,291 patients. Median total dose was 100mg (interquartile range: 35-300mg). EMS-PIs were 49% (5,575) pain/trauma, 34% (3,795) AMS, 13% (1,454) TCI, 2% (248) seizure, and 2% (219) other. Greater than 99% (11,274) were transports/assists/transfers of care to other EMS, <1% were released on scene (9) or dead on scene (8). There were 18% (2,030) with linked ED dispositions. Among those, 53% (1,068) were admitted, 40% (822) were discharged from the ED, 5% (92) transferred, 2% (34) expired in the ED, and <1% (14) AMA. Mortality status was unknown at the end of the study period for 7% (152). Of the 93% (1,878) with known mortality status, 94% (1,757) were alive and 6% (121) died. One death was excluded because physician review revealed that ketamine was never administered. Among those who had an advanced airway, 30% (46) died. Physician review determined ketamine could not be excluded as a contributing factor to death in 0.3% (6/1,878).

116. **Harris, M; Crowe, R; D'Acunto, S; Anders, J; Adelgais, K; Fishe, J. Combining traditional biostatistical analysis with natural language processing to identify new factors associated with Return of Spontaneous Circulation after Pediatric Out of Hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to use natural language processing (NLP) analysis of the EMS narrative and standard biostatistics in a large national EMS database and examine factors associated with prehospital return of spontaneous circulation (ROSC) in Pediatric out-of-hospital cardiac arrests (POHCA). This study used the data from January 1, 2019 to December 31, 2019 obtained from the ESO Data Collaborative for patients 0-18 years of age. There were 1,825 episodes of POHCA. ROSC after POHCA is associated with having an EMS-witnessed arrest and an initial shockable EKG rhythm. EMS notes reveal additional clues to potential futile resuscitations such as rigor and lividity.

117. **Crowe, RP., Fernandez, AR., Bourn, S., Myers, B. Assessing the Impact of the COVID-19 Pandemic on EMS Transport Patterns for Patients with Suspected Acute Coronary Syndrome. Oral presentation at the Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2020 and The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to describe changes in EMS use and transport patterns for patients with suspected ACS during the COVID-19 pandemic compared to a control period one year prior. This retrospective analysis used prehospital records from the ESO Data Collaborative. The authors compared responses for patients with suspected ACS from the first three months of the pandemic (study period: March 1–May 31, 2020) to the previous year (control period: March 1–May 31, 2019). Only agencies contributing records in both time periods were included. Total 9-1-1 call volume decreased 5% between the control period (1,131,399) and study period (1,071,868). Nontransports increased from 17% to 19% of all encounters ($p<0.001$). Total encounters for suspected ACS decreased by 16% (67,697 to 56,969). Suspected ACS encounters resulting in nontransport increased from 6% to 9% ($p<0.001$). Controlling for age and race/ethnicity, females with suspected ACS were less likely to be transported in the study period (aOR 0.76, 95% CI 0.72–0.81) and control period (0.81, 0.75–0.94) compared to males. Compared to white non-Hispanic patients, Hispanic patients were less likely to be transported during the study period (0.82, 0.74–0.91) and control period (0.84, 0.75–0.94). Black non-

Hispanic patients were less likely to be transported during the study period only (0.91, 0.84–0.97).

118. **Fernandez, AR., Myers, B., Crowe, RP., Bourn, S., Mills, M. A Descriptive Assessment of Prehospital Ketamine Administration Using a Statewide Data Repository. Poster presentation at the Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2020 and The annual meeting of the National Association of Emergency Medical Service Physicians. 2021. Virtual.**
The study objective was to describe patients who received prehospital ketamine in West Virginia. ESO state repository data was used for this analysis. The study included all West Virginia 9-1-1 patients who received prehospital ketamine from Jan. 1–Dec. 31, 2019. West Virginia protocols allow ketamine administration for pain and excited delirium. EMS provider impressions were categorized as pain/injury, altered mental status (AMS)/behavioral, and other. In 2019 there were 154,906 West Virginia 9-1-1 patients, and 173 (0.1%) received prehospital ketamine. In all, 62% (74) of patients with pain/injury impressions, 33% (40) with AMS/behavioral, and 6% (7) with other received ketamine. Ketamine for pain/injury was administered more often in rural areas, while ketamine for AMS/behavioral impressions was more frequent in urban areas. Those with pain/injury were older than those with AMS/behavioral impressions.

119. **Fernandez, AR., Crowe, RP., Bourn, S., Myers, B. A Comparison of EMS Patients Diagnosed with COVID-19 Before and After Reopening in the United States of America. Oral presentation at the Prehospital Care Research Forum International Scientific Symposium at EMS World Expo 2020.**
The study objective was to compare EMS encounter and demographic characteristics of patients diagnosed with COVID-19 before and after the first reopening. All 9-1-1 patients from the national ESO Data Collaborative who had a hospital ICD-10 diagnosis of COVID-19 were included. For the analysis, March 15–April 30, 2020, represented “before reopening”; May 1–June 15, 2020, represented “after reopening.”. There were 1,844 COVID-19-diagnosed 9-1-1 patients before reopening and 1,765 after reopening. The median age before reopening (69; interquartile range [IQR] 55–81) was significantly ($p < 0.01$) higher than after reopening (64.5; IRQ 50–78). More patients were less than 40 years old after reopening (18%, 326 vs. 24%, 421, $p < 0.001$). EMS patients diagnosed with COVID-19 were younger after the easing of stay-at-home orders. Also after reopening, more patients were reported to be Hispanic/Latino or other race, and slightly more patients were transported from homes/residences and healthcare facilities.

120. **Robinson, E.J., Watanabe, B., Brown, L.H. Prehospital Ketamine Administration for Pain Control**
Does Not Prolong Emergency Department Length of Stay. The annual meeting of the Society for Academic Emergency Medicine. 2020. Virtual Meeting
The study objective was to compare ED length of stay among EMS patients who received prehospital ketamine, fentanyl or morphine specifically for pain control. The 2018 ESO research dataset was used for this analysis. There were 10,493 patients that met inclusion criteria. Of those, 131 received ketamine, 8,809 received fentanyl, and 1,553 received morphine. Median (IQR) ED length of stay was 3.6 (2.6-6.1) hours for patients who received ketamine, 3.8 (2.7-5.5) hours for patients who received fentanyl, and 4.1 (2.7-6.2) hours for patients who received morphine ($p<0.001$). In post-hoc pairwise comparisons, patients who received morphine had significantly longer ED length of stay than patients who received fentanyl ($p<0.001$); there was no significant difference in ED length of stay for patients who received ketamine vs. morphine ($p=0.131$), or for patients who received ketamine vs. fentanyl ($p=0.875$).

121. **Houston, S., Dean, B., Taylor, S., Howell, S., Cornelius, C. Pediatric CARE (Cardiac Arrest Resuscitation by EMS). ESO Wave 2020. 2020. Austin, TX.**

The study objective was to examine the effect of determinants on the likelihood of achieving return of spontaneous circulation in pediatric out-of-hospital cardiac arrest. The ESO 2017 Research Dataset was used for this analysis. Witnessed arrests were more likely to achieve return of spontaneous circulation. CPR feedback devices showed statistical significance in achieving return of spontaneous circulation in pediatric out-of-hospital cardiac arrest when utilized. Caucasian pediatric out-of-hospital cardiac arrest and early epinephrine administration also improved the likelihood of return of spontaneous circulation.

122. **Moore, A., Clemency, B.M., Brown, L.H., Vital Signs Are an Effective Predictor of EMS-witnessed Cardiac Arrest. ESO Wave 2020. 2020. Austin, TX.**
The study objective was to explored whether an existing vital signs-based risk assessment score or a simple count of abnormal vital signs (level of consciousness; heart rate; respiratory rate; systolic blood pressure) can identify patients at risk for EMS-witnessed arrest. The ESO 2018 Research Dataset was used for this analysis. This study compared the ability of the Modified Early Warning Score (based on first recorded vital signs, excluding temperature) and the count of abnormal first recorded vital signs to differentiate adult non-traumatic EMS-witnessed arrest patients from non-arrest but emergently transported patients. Vital sign-based assessments can help identify patients at risk for EMS-witnessed arrest. The absence of at least 3 normal vital signs indicates increased risk of EMS-witnessed arrest. The study found that using the count of abnormal vital signs sacrifices some sensitivity but is easier than calculating the Modified Early Warning Score.

123. **Crowe, R.P., Myers, B., Fernandez, A.R., Bourn, S. McMullan, J.T. Prehospital Performance of the Cincinnati Prehospital Stroke Scale Compared to LVO-specific Instruments for Identifying LVO Stroke. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to determine whether newly-developed LVO stroke scales offer a clinically-meaningful advantage over the Cincinnati Prehospital Stroke Scale (CPSS). The 2018 ESO Health Data Exchange research dataset was used for this analysis. CPSS was compared to the Rapid Arterial Occlusion Evaluation (RACE), Los Angeles Motor Scale (LAMS), and the Vision, Aphasia, Neglect (VAN) assessment for LVO prediction. In this large sample of real-world prehospital patient encounters, the CPSS demonstrated similar predictive performance characteristics compared to the RACE, LAMS, and VAN for detecting LVO stroke.

124. **Crowe, R.P., Myers, B., Fernandez, A.R., Myronenko, V., Bourn, S. McMullan, J.T. Factors Associated with Failure to Document a Prehospital Stroke Screen in Patients Diagnosed with Stroke/TIA. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to describe factors associated with reduced likelihood of EMS documenting a stroke screen among a cohort of patients diagnosed with stroke. The 2018 ESO Health Data Exchange research dataset was used for this analysis. Of 13,323 patients with hospital diagnosed stroke/TIA, 51% (n = 6,824) were acute ischemic stroke (AIS), 24% were nontraumatic intracranial hemorrhages (ICH) (n = 3,236), 19% were TIA (n = 2,572), and 5% involved multiple stroke types (n = 691). Approximately one-third of EMS patients with hospital-diagnosed stroke/TIA did not have a prehospital stroke screen documented. Younger age, ICH, and presence of injury were associated with reduced odds of stroke screen documentation.

125. **Crowe, R.P., Fernandez, A.R., Schroeder R., Bourn, S., Myers, B. Evaluating the Utility of Prehospital Shock Index and Modified Shock Index to Predict Hospital Sepsis and Septic Shock Diagnosis. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**

The study objective was to evaluate initial prehospital Shock Index (SI), Modified Shock Index (MSI), and Systolic Blood Pressure (SBP) as predictors of hospital sepsis/septic shock diagnosis. The 2018 ESO Health Data Exchange research dataset was used for this analysis. Elevated initial prehospital SI and MSI demonstrated stronger associations with sepsis diagnosis compared to SBP < 90 in this population.

126. **Fernandez, A.R., Crowe, R.P., Bourn, S., Myers, B. Prehospital Recognition of Patients Diagnosed with Sepsis and Septic Shock. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to estimate EMS sepsis recognition and describe prehospital characteristics of patients diagnosed with sepsis/septic shock. The 2018 ESO Health Data Exchange research database was used for this analysis. There were 325,558 adult non-trauma patients with linked EMS-hospital records, 16,881 (5.2%) were diagnosed with sepsis. Of these, 18.6% (3,144/16,881) were diagnosed with septic shock. Sepsis and septic shock patient vital signs were consistent with their diagnosis. Prehospital temperature was not documented consistently. Sepsis/Septicemia was infrequently documented as the primary or secondary impression.

127. **Fernandez, A.R., Crowe, R.P., Bourn, S., Myers, B. Variation in Use of Lights and Sirens for Patient Transport: A National, Agency-Level Comparison. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to describe variability in L&S use for scene-to-hospital 9-1-1 transports among a national cohort of EMS agencies. The 2018 ESO research dataset was used for this analysis. There were 1,190 EMS agencies analyzed, representing 3,634,564 scene-to-hospital transports that met inclusion criteria. Overall, 13.8% (499,714/3,632,564) of 9-1-1 patients were transported using lights and sirens. Almost half of EMS agencies used lights and sirens for 10% or less of scene-to-hospital 9-1-1 patient transports. Nevertheless, approximately 1 out of 8 agencies had documented lights and sirens use for more than 50% of transports.

128. **Jarvis, J., Johnson, B., Crowe, R.P. Prehospital Epidemiology and Treatment of Patients with Atraumatic Headache. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to describe the epidemiology and treatment of prehospital atraumatic headaches in adults. The secondary objective was to describe meaningful pain reduction by commonly administered medications. The 2018 ESO research dataset was used for this analysis. Of the 5,977,612 emergency responses, 66,235 (1.1%) had an impression of headache/migraine and 34,763 (52.5%) met inclusion criteria. Prehospital pain scores were documented infrequently. Less than one-fifth of patients with initial pain scores >5 received medication.

129. **Escott, M.E., Crowe, R.P., Brown, L. An Epidemiological Description of Traumatic Out-of-Hospital Cardiac Arrest. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to describe EMS encounters for traumatic out-of-hospital cardiac arrests (Tr-OOHCA) among a nationwide cohort of EMS systems, and identify factors associated with return of spontaneous circulation (ROSC) and survival. The 2018 ESO research dataset was used for this analysis. ROSC was documented in 19.9% of cases. In this large US-based dataset, resuscitation of Tr-OOHCA was not futile, with ROSC and survival rates similar to those for all-rhythm medical OOHCA. Although ROSC appears more likely in some patient subgroups, no demographic or clinical Tr-OOHCA subgroup had ROSC rates near zero.

130. **Stopyra, J., Crowe, R.P., Snavely, A., Page, N., Ashburn, N., Foley, K., Miller, C., Mahler, S. Rural Health Time to Care Disparities for Prehospital Patients with Suspected STEMI. The annual**

meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.

The study objective was to compare rural vs. urban time intervals among a national cohort of prehospital patients with suspected STEMI. The 2018 ESO research dataset was used for this analysis. Of 3,480,473 adult 9-1-1 transports, 8,079 had a provider STEMI impression and were included in the analysis. Most responses (79%, n ¼ 6,382) occurred in urban settings. In this large national dataset of patients with suspected STEMI, rural patients had longer critical prehospital-hospital time intervals compared to urban patients. Rural patients were less likely to have EMS arrival-destination transport times under 60 minutes and had longer response and total EMS times.

131. George T.P., Chan, H.K., Crowe, R.P., Jarvis, J., Jansen, J., Wang, H. Characteristics of Out-of-Hospital Shock in a National Cohort of Emergency Medical Services Agencies. The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.

The study objective was to describe the clinical characteristics and course of shock care in a national cohort of EMS agencies. The 2018 ESO research dataset was used for this analysis. Among 6,156,895 adult 9-1-1 responses from 1,289 EMS agencies, shock was present in 62,876 (1.02%; 95%CI:1.01–1.03), including 54,239 (86.3%) medical and 5,978 (9.5%) traumatic, and 2,650 unknown. In this national series, 1 of every 100 EMS encounters involved shock. Approximately 1 of every 10 shock patients did not improve with EMS care.

132. Jarvis J., Hamilton V., Taigman M., Brown L. Results of Using Red Lights and Sirens for Emergency Ambulance Calls: How Often Are Potentially Life-Saving Interventions Performed? The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.

The study objective was to identify and describe the frequency and nature of 9-1-1 calls that result in potentially life-saving interventions (pLSI) at any time during the call and within 6 minutes of EMS arrival. The 2018 ESO research dataset was used for this analysis. There were 5,393,570 calls from 1,199 agencies included in the analysis. The majority (86.1%) of calls utilized RLS, yet few (5.0%) resulted in pLSI. In this large national dataset, RLS responses were very common (86%) yet potentially lifesaving interventions were infrequent and rarely performed within 6 minutes of arrival on scene.

133. Van Vleet, L., Burton, B., Crowe, R.P., Page, D., Wang, H. A Descriptive Assessment of EMS Encounters for Patients Experiencing Behavioral Health Emergencies. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA. and the annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.

The study objective was to describe characteristics of EMS patients experiencing behavioral health emergencies. The 2018 ESO Health Data Exchange research database was used for this analysis. Inclusion criteria consisted of 9-1-1 responses for adult patients (older than 18 years) with a documented EMS provider primary or secondary impression of a behavioral or psychiatric etiology transported to the ED. Substance abuse and overdose were specifically excluded. A behavioral health emergency was present in 213,410 (4%) of responses. There were 21,901 (10%) excluded because the patient age less than 18. Of the remaining 191,509 encounters, there were 146,124 (76%) transports by EMS. Median age was 41 (IQR 29–56), 51% were male, 69% were white (non-Hispanic) and 25% were black (non-Hispanic). Hospital outcome data was available for 15,500 encounters (11%). Of these, 51% (7,948) were discharged home in 24 hours or less.

134. **Wampler, D., Tenley, L., Crowe, R.P., Jarvis, J., The Epidemiology of EMS-Witnessed Cardiac Arrest in a U.S. Patient Cohort. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA. and The annual meeting of the National Association of Emergency Medical Service Physicians. 2020. San Diego, CA.**
The study objective was to describe the epidemiology of EMS-witnessed cardiac arrests. The 2018 ESO research dataset was used for this analysis. Of the emergency responses for documented cardiac arrests among adult patients, EMS witnessed 8,014 (13%). Among EMS-witnessed cardiac arrest patients, median age was 65 (IQR 53–76), 71% were white (non-Hispanic), and 60% were male. Presumed etiology of EMS-witnessed arrests included cardiac (54%), followed by respiratory (25%), trauma (12%), and drug overdose (2%). Initial arrest rhythm was shockable in 21% of witnessed arrests, while PEA or asystole was documented in 73% of cases. Common locations where EMS-witnessed cardiac arrests occurred included residences (70%), streets/highways (10%), and nursing homes/assisted living centers (8%). Circulation was restored in 43% of cases.

135. **Schroeder, R., Crowe, R.P., Myers, B., Bourn, S., Fernandez, A.R. Evaluating the Utility of Initial Prehospital Shock Index and Modified Shock Index to Predict Hospital Sepsis and Septic Shock Diagnosis. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to evaluate prehospital initial shock index and modified shock index as predictors of hospital sepsis diagnosis. The 2018 ESO Health Data Exchange research database was used for this analysis. All medical 9-1-1 responses with linked hospital diagnoses were included. Patients under 18 and those with traumatic injuries were excluded. Sepsis/septic shock diagnosis was defined using hospital ICD10 codes. Shock Index was calculated by dividing initial heart rate by SBP. Modified Shock Index was calculated by dividing initial heart rate by mean arterial pressure. Elevated Shock Index was defined as >1.0 and elevated Modified Shock Index was >1.3. Multivariable logistic regression models were used to evaluate Shock Index and Modified Shock Index as predictors of sepsis/septic shock, controlling for patient age, gender, race/ethnicity, community size, and geographic region. Over a five-fold increase in odds of sepsis diagnosis was observed for patients with an elevated initial SI (aOR:5.30, 95%CI:5.08-5.52) or MSI (aOR:5.42, 95%CI:5.21-5.64). A nine-fold increase in odds of septic shock was observed for patients with an elevated SI (aOR:9.05, 95%CI:8.32-9.85) or MSI (aOR:8.61, 95%CI:7.92-9.36). Elevated Shock Index and Modified Shock Index were strongly associated with hospital sepsis diagnosis among this group of all EMS encounters for patients with a presumed medical etiology.

136. **Alier, A., Kaye, S.P., Wilson, J.K., Wronski, R.A., Fernandez, A.R. Evaluating the Current EMS Workforce in South Carolina. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to describe the current EMS workforce in South Carolina with respect to patient contacts, number of agency rosters on which they appear, roles, and years of experience. ESO state repository data was used for this analysis. This cross-sectional evaluation included all certified South Carolina EMS professionals in 2019. There were 11,197 South Carolina EMS certified individuals in 2019. Of those, 3,138 (27.9%) were not listed on any agency rosters. There were 8,069 (72.1%) who appeared on at least 1 agency roster. Number of rosters ranged from 1 to 20 with a median of 1 (interquartile range [IQR]: 1-2). There were 1,757 (21.8%) individuals who appeared on a roster but, had no patient contact within the last 12 months. There were 7,823 field providers. Experience ranged from <1 to 47.1 years with a median of 5.2 (IQR: 2.4-11.3). There were 545 in management/operations. Experience ranged from <1 to 47 years with a median of 14.1 (IQR: 6.3-24.6). There were 360 in leadership/administration. Experience ranged from <1 to 47 with a median of 17.0 (IQR: 7.3-26.5). There were 29 educators. Experience ranged from 3.7 to 46.8 years with a median of 16.0 (IQR: 8.9-27.2).

137. **Renkiewicz, G.K., VanVleet, L., Baggett, B., Elmore, A., Ross, M., Martin, M. Disparate Treatment of the Pediatric Diabetic Patient in the Prehospital Setting. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to identify disparities in the prehospital treatment of pediatric diabetic emergencies. The 2017 ESO research dataset was used for this analysis. Inclusionary criteria consisted of patients whose lowest blood glucose level was less than 70 mg/dL, had a total Glasgow Coma Score of 14 or less, and had a primary impression that suggested a potential blood glucose level abnormality. A primary impression of altered level of consciousness was statistically significant (OR 8.05, p=0.029) regarding the treatment of prehospital pediatric hypoglycemia. The study identified no discernable disparity in the treatment of prehospital pediatric diabetic patients filtered by age in years, weight, gender, or minority status.

138. **Renkiewicz, G.K., Dean, B., Houston, S., Taylor, S., Howell, S., Cornelius, C. Pediatric Cardiac Arrest Resuscitation by EMS (CARE). The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to examine factors influencing the likelihood of achieving field return of spontaneous circulation in pediatric out-of-hospital cardiac arrest. The 2017 ESO research dataset was used for this analysis. Compared to unwitnessed arrests, patients were more likely to achieve return of spontaneous circulation when arrests were witnessed by a healthcare provider (OR 6.53, p=0.003), bystander (OR 2.94, p=0.001), or family member (OR 2.77, p=0.016). Field return of spontaneous circulation was also associated with Caucasian race (OR 2.39, p=0.004), use of CPR feedback device (OR 2.21, p=0.007), and quicker epinephrine administration (OR 0.98, p=0.042 per minute from 9-1-1 call received time to first epinephrine administration). The child age group (2–18 years) also exhibited improved odds of ROSC (OR 2.11, p=0.008).

139. **Burchette, E., Hubble, M.W., Renkiewicz, G.K., Stallings, D., Tripp, H. Impact of Delayed Epinephrine Administration on Return of Spontaneous Circulation During Pediatric Out-of-Hospital Cardiac Arrest. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to evaluate the effect of vasopressor administration delay on field return of spontaneous circulation in pediatric out-of-hospital cardiac arrest. The 2017 ESO research dataset was used for this analysis. Patients receiving advanced airway control prior to epinephrine administration had longer scene-arrival-to-pressor intervals (24.9 vs. 19.3 minutes, p<0.01). Significant adjusted odds ratios for return of spontaneous circulatio included call-receipt-to-pressor interval (per minute; OR 0.97, p<0.01); patient age (per year; OR 1.06,p<0.01); non-Caucasian race (OR 0.43, p=0.01); and witnessed arrests (OR 2.88, p<0.01). In addition, compared to arrests of cardiac etiology, arrests of respiratory (OR 2.42, p=0.01) and other etiologies (OR 2.12, p=0.04) were more likely to attain return of spontaneous circulation. An increased likelihood of return of spontaneous circulation was associated with an initial ECG of VF/VT or shockable AED rhythm (OR 3.06, p<0.01), PEA (OR 5.97, p<0.01), and unknown AED nonshockable rhythm (OR 8.42, p=0.03) when compared to asystole.

140. **Van Vleet, L., Baggett, B., Elmore, A., Ross, M., Martin, M. Likelihood of Bystander CPR in Pediatric Cardiac Arrest. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to determine the incidence of layperson CPR in witnessed pediatric cardiac arrest and demographic factors that may impact the likelihood of layperson efforts. The 2017 ESO research dataset was used for this analysis. Among the 269 pediatric patients included in the study, 54.8% received layperson CPR. Gender was the only factor that showed a statistically significant (p=0.048) difference in the odds of bystanders to perform CPR, with

females 2.05 times greater odds than males to receive layperson CPR. There was no difference in age, weight, race, and cardiac arrest etiology regarding performance of layperson CPR.

141. **Renkiewicz, G.K., Tripp, H.E., Burchette, E., Stallings, D. A., Hubble, M.W. An Epidemiology of Pediatric Suicide Attempts. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to describe epidemiological and patient-related factors of a nationwide population of prehospital pediatric suicide attempts. The 2017 ESO research dataset was used for this analysis. Mean age was 15.5 ± .05 years with a range of 6–18. Patients identified as prepubescent (<13 years) accounted for 15.3% (n=413) of the sample. Average EMS response time was 11.75 ±33.36 minutes, and 457 (16.9%) attempts had a traumatic component. Suicidal ideations without actual attempt were the highest subgrouping (n=990; 36.7%), followed by nonspecific suicide attempt (n=414; 15.3%), overdose (n=390; 14.5%), lacerations (n=172; 6.4%), and depressive symptoms (n=101; 3.75%). Upon EMS arrival, 5 patients were observed to be in cardiac arrest. Of these, resuscitation was attempted on 2, and 1 achieved return of spontaneous circulation. Twelve patients were intubated.

142. **Renkiewicz, G.K., Watkins, A., Collopy, K., Hoover, J., Tuttle, J. Impact of Pediatric Age Groups on Prehospital Intubation Success. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to evaluate whether prehospital overall endotracheal intubation success varied based on patient age. The 2017 ESO research dataset was used for this analysis. Adolescents were the most commonly intubated age group (n=164; 29.66%), followed by infants (n=160; 28.93%), toddlers (n=82; 14.82%), school-aged children (n=60; 10.84%), preschoolers (n=45; 8.13%), and neonates (n=42; 7.59%). Compared to adolescents, neonates (OR 0.404; p=0.014) and those patients not receiving paralytics were less likely to obtain overall endotracheal intubation success (OR 0.404; p=0.049). Neither sex nor minority status were statistically significant predictors of ETI success.

143. **Van Vleet, L., Baggett, B., Elmore, A., Ross, M., McNeil, M. Treatment Equity Among Pediatric Diabetic Patients in the Prehospital Setting. The Prehospital Care Research Forum International Scientific Symposium at EMS Expo. 2019. New Orleans, LA.**
The study objective was to identify disparity in prehospital treatment of pediatric diabetic emergencies. The 2017 ESO research dataset was used for this analysis. Inclusion criteria consisted of patients whose lowest blood glucose level was less than 70 mg/dL and had a total Glasgow coma score of 14 or less and a primary impression that may have been related to blood glucose level abnormalities. total of 36.7% (92) patients received an included treatment modality, and 63.3% (159) patients were not treated. This study identified no discernable disparity in treatment of prehospital pediatric diabetic patients when examined by age in years, weight, gender, or minority status.

144. **Mills, M., Crowe, R.P., Myers, B., Wilson, J.K., Kaye, S.P., Fernandez, A.R. An Assessment of the Relationship between the Total Prehospital Naloxone Dose Administered and EMS Transport in West Virginia. The 2019 National Association of State EMS Officials Annual Meeting. 2019. Salt Lake City, UT. Awarded 1st Place Research Abstract.**
The study objective was to assess the relationship between the total dose of prehospital naloxone administered and EMS transport of suspected opioid patients to an emergency department in West Virginia. ESO state repository data was used for this analysis. All 9-1-1 calls where one or more doses of prehospital naloxone were administered in West Virginia from January 1, 2016 to December 31, 2017 were assessed. There were 613,011 total 9-1-1 call and 1.5% where the patient received prehospital naloxone in West Virginia during the study period. Of those, 82.2% were transported and 17.8% were not transported. The assessment of the

relationship between total prehospital dose of naloxone and patient transport in West Virginia did not reveal a significant relationship. The average total dose for those who were not transported was 1.6 milligrams (standard deviation 0.7) with a median of 2 (interquartile range 1-2).

145. **Wilson, J.K., Crowe, R.P., Myers, B., Ezzell, Zalkin, J., Nelson, R.D., Winslow, J., Fernandez, A.R. North Carolina EMS Providers' Experiences and Attitudes Regarding Workplace Violence and Safety. The 2019 National Association of State EMS Officials Annual Meeting. 2019. Salt Lake City, UT.**
The study objective was to assess the proportion of EMS providers in North Carolina who reported one or more forms of assault while on duty in the past 24 months and to identify demographic and work-related factors associated with the report of being assaulted. Secondarily, EMS providers' attitudes regarding workplace safety and management of workplace assaults events were examined. All responses obtained from an online survey distributed via multiple listservs for EMS providers in North Carolina in June and July of 2018 were assessed. Over two-thirds of respondents indicated that they had been physically or verbally assaulted in the workplace in the last 24 months. Those who reported an assault in the last 24 months felt less safe at work and less able to manage physical violence. There was an increase in perceived ability to manage violence by those who had not experienced violence potentially indicating that providers are overconfident or unaware of potential threats.

146. **Alier, A., Kaye, S.P., Crowe, R.P., Myers, B., Wronski, R.A., Wilson, J.K., Fernandez, A.R. An Assessment of EMS Longevity and the Current EMS Workforce in South Carolina. The 2019 National Association of State EMS Officials Annual Meeting. 2019. Salt Lake City, UT.**
The study objective was to describe the length of time EMS providers in South Carolina remain in the workforce and identify factors related to longevity. ESO state repository data was used for this analysis. All EMS providers who held an EMS certification in South Carolina from 1970 to 2019 were assessed. Those currently certified in South Carolina have similar years of EMS experience and are similar in age to those who are no longer certified. Currently certified individuals may be on the verge of leaving the field. Moreover, this study revealed that almost three-quarters of the South Carolina EMS workforce maintained their EMS certification for less than 8 years, over 90% don't make it to 20 years of service and over 98% do not accumulate enough service time to retire from EMS. Females maintain EMS certification for fewer years compared to males and EMTs maintain certification for fewer years compared to paramedics.

147. **Humlen-Ahearn, P., Hadland L., Crowe R.P., Brown L., Using Prehospital Screening Tools to Identify Large-Vessel Occlusion, in National Association of EMS Physicians. ESO Wave 2019. 2019: Austin, TX.**
The study objective was to determine the test characteristics for commonly used prehospital stroke scales for detecting large-vessel occlusion. The 2017 ESO research database was used for this analysis. The study included all patients with both a stroke screening and health data exchange hospital outcome data. large-vessel occlusion was identified using ICD-10 diagnosis. There were 1,712 patients with both stroke screening and HDE outcome data, 3% had documented large-vessel occlusion. Only 14% of the patients were assessed using RACE/LAMS. The sensitivity of RACE/LAMS was 100% (CI: 60%-100%) and the negative predictive value was 100% (CI: 97%-100%), but the specificity (53%, CI: 46%-59%) and positive predictive value (6%, CI: 2%-12%) were poor. Use of the LAMS/RACE>/4 stroke-screening tools or two or more screening characteristics by EMS is a poor predictor of large-vessel cerebral occlusions.

148. **Jarvis, J., Biasatti M., Gonzales J., Johns D. Esmolol Use for Refractory Ventricular Fibrillation: A Prehospital Case Series, in National Association of EMS Physicians. ESO Wave 2019. 2019: Austin, TX.**

The study objective was to describe the characteristics of patients in refractory VF treated with esmolol. ESO data from a single suburban EMS system was used for this analysis. Between October 2017 and June 2018, thirteen patients received esmolol 500 mcg/kg bolus followed by an infusion. There was no significant difference between the esmolol and non-esmolol groups on any variable evaluated in this study. The use of esmolol did not improve outcomes but it did decrease the proportion of patients transported with CPR in progress.

149. **Waddell, M. Focused Stroke Education in Emergency Medical Services (EMS). 2019. ESO Wave 2019. Austin, TX.**
The study objective was to determine if there was a significant difference in the number of stroke patients that bypassed local primary stroke centers prior to and after attending Advanced Stroke Life Support education. ESO data from a single county-based EMS system was used for this analysis. Three years of EMS clinical data prior to Advanced Stroke Life Support education was compared to three years of clinical data following Advanced Stroke Life Support education. Results from this study indicated that Advanced Stroke Life Support training did not reduce the likelihood of EMS providers by-passing local primary stroke centers.

150. **Ashburn, N., Ryder C.W., Angi R.M., Snavely A.C., Nelson R.D., Bozeman W.P., McGinnis H.D., Winslow J.E., Stopyra J.P. One-Year Mortality After Receiving Prehospital Naloxone for Suspected Opioid Overdose, in Society for Academic Emergency Medicine. 2019: Las Vegas NV.**
The objective of this study was to determine the one-year mortality rate of patients who receive prehospital naloxone from emergency medical services. ESO data from seven North Carolina county EMS agencies was queried for naloxone administration over a twenty-six-month period (1/2015-2/2017). There were 3,099 naloxone administrations. Nearly 15% of patients died within one-year of receiving prehospital naloxone.

151. **Arkins, T., Sigle R., Page D., Crowe R.P. Barton D, Can 911 Dispatchers Reliably Identify Patients Suffering a Stroke?, in National Association of EMS Physicians 2019: Austin, TX.**
The study objective was to evaluate the ability of a 911 dispatcher to reliably identify a patient who is suffering a stroke or transient ischemic attack. The 2017 ESO research database was used for this analysis. Only run types listed as 911 responses with health data exchange hospital outcomes of stroke or TIA were included. A total of 2,199 cases were identified for inclusion and analysis. Dispatchers were able to correctly identify a stroke patient 39% of the time. Dispatchers are not able to reliably identify a patient suffering a stroke or TIA.

152. **Burton, B., Van Vleet L., Crowe R.P., Page D., Barton D., Wang H., Disparities in Prehospital Analgesia for Trauma Patients in the United States, in Prehospital Care Research Forum EMS World Expo & National Association of EMS Physicians. ESO Wave 2019. 2018/2019: Nashville and Austin.**
The study objective was to characterize differences by age, sex, race, and region in EMS analgesia administration to injured patients. The 2017 ESO research database was used for this analysis. There were 118,203 injured patients with pain score ≥7 and 9% received analgesia. EMS analgesia administration differs by age, sex, race and region. Average age among this injured patient population was 50 years and 43% were male. Compared with young adults (age 18-29 years), children were less likely to receive analgesia (OR: 0.57, 95% CI: 0.45-0.70). Older patients (≥70 years) were more likely to receive analgesia (OR: 1.18, 95% CI: 1.10-1.26). Males were more likely to receive analgesia (OR: 1.23, 95% CI: 1.19-1.29) Patients identified as Black or African American were less likely than White, non-Hispanic patients to receive analgesia (OR: 0.60, 95% CI: 0.56-0.63).

153. **Jarvis, J., Phillips D., Crowe R.P. Response, Agency, and Patient Characteristics Associated with EMS Transport Rates, in Prehospital Care Research Forum EMS World Expo & National Association of EMS Physicians. 2018/2019: Nashville & Austin.**
The study objective was to identify response, agency and patient characteristics associated with EMS transport rates. The 2017 ESO research database was used for this analysis. There were 2,786,615 electronic health records; 85% resulted in EMS transport by over 900 agencies. Compared to third service agencies, private agencies demonstrated 80% greater odds of transporting (aOR:1.80, 95%CI:1.78-1.84). Compared to non-volunteer agencies, volunteer agencies demonstrated 31% increased odds of transport (aOR:1.31, 95%CI:1.26-1.36). Hispanic patients demonstrated 26% decreased odds of transport compared to non-Hispanic White patients (aOR:0.74, 95%CI:0.73-0.75). Compared to patients aged 18-39, patients in older patients had progressively greater odds of transport with each age group, the largest aOR being 2.62 (95%CI:2.59-2.65) for those over 79. Patients younger than 18 years had lower odds of transport (aOR:0.74, 95%CI:0.73-0.75).

154. **Kordik, S., Smith C., Page D., Crowe R.P., Myers B., Wampler D. Increased Frequency of Adverse Events Observed after Ketamine Use for Psychiatric Emergency as Compared to Benzodiazepines and Antipsychotics, in Prehospital Care Research Forum EMS World Expo & National Association of EMS Physicians. 2018/2019: Nashville & Austin.**
The study objective was to evaluate adverse events after administration of ketamine compared to benzodiazepines or antipsychotics in the prehospital treatment of psychiatric patients. The 2017 ESO research database was used for this study. The analysis included patients over 13 years experiencing a psychiatric emergency and receiving a single dose of ketamine, benzodiazepine, or antipsychotic. There were 3,020 patients included, 11% received ketamine, 71% received a benzodiazepine, and 17% received an antipsychotic. The adverse event rate for all psychiatric patients administered sedation was ≤11%. For psychiatric patients requiring treatment, those who received ketamine received significantly more airway management than patients who received a benzodiazepine or antipsychotic.

155. **Jarvis, J., Wampler D., Wang H. First Pass Airway Success Rates Out-of-Hospital Advanced Airway Management in Adults and Children, in Prehospital Care Research Forum EMS World Expo & National Association of EMS Physicians. ESO Wave 2019. 2018/2019: Nashville & Austin.**
The study objective was to compare advanced airway management first-pass success rates between adults and children. The 2017 ESO research database was used for this analysis. All patients receiving any advanced airway management attempts were included. Advanced airway management was attempted on 29,369 patients including 28,846 (98.2%) adults and 523 (1.8%) children. endotracheal intubation first pass success was lower in children than adults (58.6% vs 72.7%). Supraglottic airway first pass success does not differ between children and adults (84.6% vs 89.8%).

156. **Jarvis, J., Curtis L., Prehospital Use of Ketamine, Morphine or Fentanyl for the Management of Acute Pain Following Traumatic Injury, in Prehospital Care Research Forum, EMS World Expo & National Association of EMS Physicians. ESO Wave 2019. 2018/2019: Nashville & Austin.**
The study objective was to compare the analgesic effects of low-dose ketamine, fentanyl, and morphine for the treatment of acute, traumatic pain in the prehospital environment. The 2017 ESO research database was used for this analysis. All patients >12 years old with an initial pain score of ≥ 5 and at least one subsequent pain score documented who were treated with ketamine, fentanyl, or morphine following traumatic injury were included. There were 35,906 analyzed, 80.0% received fentanyl, 18.2% received morphine, and 1.8%received ketamine. There was no significant difference in pain reduction when the ketamine group (84.8%) was

compared to either the fentanyl group (85.8%) or the morphine group (83.6%), but fentanyl was associated with significant reduction in pain compared to morphine.

157. **Jarvis, J., Phillips D., Crowe R.P. Characteristics of EMS Transport Refusal Following Glucose or Naloxone Administration, in Prehospital Care Research Forum EMS World Expo & National Association of EMS Physicians. ESO Wave 2019. 2018/2019: Nashville and Austin.**
The study objective was to describe the characteristics of transport refusal among patients who received glucose, naloxone, or neither medication. The 2017 ESO research database was used for this analysis. The analysis included 2,778,921 electronic health records. Transport refusal rates were higher for those given glucose and lower for those given naloxone compared with those given neither. Overall, 14% of all responses resulted in transport refusal with 7% of those given naloxone, 39% given glucose, and 14% given neither drug refusing transport.

158. **Jarvis, J., Barton D., Sager L., Nudell N. Benchmarking EMS Compass Stroke Performance Measures Using a Large National Dataset, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national stroke performance measure benchmarks including prehospital use of stroke screening tools and assessment of blood glucose levels among EMS stroke patients. Six and a half years of ESO data were analyzed. There were 168,854 patients who had a impression of acute stroke and were transported from the scene of a 9-1-1 call included in the analysis. Of those, 52.6% had a documented stroke scale and 83.1% had a documented glucose level. This was the first study to calculate national benchmarks for stroke related EMS Compass measures.

159. **Jarvis, J., Barton D., Sager L., Nudell N. Benchmarking EMS Compass Performance Measures using a Large National Dataset: Pediatric Care, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national pediatric performance measures benchmarks including documentation of weights, SpO2, Respiratory Rate, for those with any respiratory illness as well as at least one dose of beta-agonist given for those with asthma and an SpO2 90%. Six and a half years of ESO data were analyzed. There were 524,856 9-1-1 patients under 15 years of age included in the analysis with 54.8% having a documented weight. There were 43,067 children with a respiratory impression and 87.5% of these had at least one documented SpO2 and Respiratory Rate. Of the 755 children with an impression of asthma and SpO2 <90%, 84.1% received a beta-agonist. This was the first study to calculate national benchmarks for pediatric related EMS Compass measures.

160. **Jarvis, J., Barton D., Sager L., Nudell N. Benchmarking EMS Compass Cardiac Performance Measures using a Large National Dataset, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national benchmarks for national cardiac performance measures including the time from dispatch to first defibrillation in shockable rhythms, the proportion of these provided within 5 minutes, the proportion of patients over 35 with non-traumatic chest pain who received both aspirin and a 12 lead ECG, and the proportion of patients with acute decompensated heart failure (as defined by SBP > 200 and either a RR > 30 or an SpO2 < 90) who received both nitroglycerin and non-invasive pressure ventilation. Six and a half years of ESO data were analyzed. There were 11,144 cardiac arrests with an initial shockable rhythm, 14.6% were defibrillated within 5 minutes and the average time to first shock was 13.65 minutes. There were 533,127 patients over 35 with non-traumatic chest pain, 37.4% received both aspirin and a 12 lead ECG. There were 2,612 patients with acute decompensated heart failure and 80.4% received both nitroglycerin and non-invasive pressure ventilation. This

was the first study to calculate national benchmarks for cardiac related EMS Compass measures.

161. **Jarvis, J., Barton D., Sager L., Nudell N. Benchmarking the Use of Red Lights and Sirens in 9-1-1 Systems: A Review of a Large National Dataset, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national benchmarks for red lights and sirens utilization performance measures. Six and a half years of ESO data were analyzed. There were 7,709,012 9-1-1 calls that resulted in patient transport. 75.8% utilized red lights and sirens to the scene and 19.4% utilized red lights and sirens from the scene to the hospital. This was the first study to calculate national benchmarks for red lights and sirens use related EMS Compass measures.

162. **Jarvis, J., Barton D., Sager L., Nudell N. EMS Compass Benchmarks using a National EMS Dataset: Status Epilepticus and Hypoglycemia Performance Measures, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national benchmarks for status epilepticus and hypoglycemia performance measures. Six and a half years of ESO data were analyzed. There were 147,238 patients with documented blood glucose <60, 79.7% received glucose. There were 11,148 patients with status epilepticus, 72.4% had a documented blood glucose and 56.1% had a benzodiazepine administered. This was the first study to calculate national benchmarks for status epilepticus and hypoglycemia related EMS Compass measures.

163. **Jarvis, J., Barton D., Sager L., Nudell N. Benchmarking EMS Compass Trauma Scene Times and Traumatic Pain Management Performance Measures using a National Dataset, in National Association of EMS Physicians. 2018: San Diego, CA.**
The study objective was to describe national benchmarks for trauma scene times and traumatic pain management performance measures. Six and a half years of ESO data were analyzed to calculate benchmarks for: (1) the percentage of patients with trauma alert criteria as defined by the CDC trauma triage criteria for transport to a trauma center who have a scene time under 10 minutes, and (2) of patients with any traumatic injury, the proportion with at least one pain scale documented. For those with an initial pain score >5, the proportion with a second score reassessing pain. Of patients from ALS agencies who had an initial score >5, the proportion with decreased pain from the first to last pain score. There were 66,414 critical trauma patients and 24.3% had a scene time less than 10 minutes. The average scene time was 16.4 minutes. There were 2,166,680 trauma patients, 48.6% had a documented pain score. Of the 503,656 patients with an initial pain score of >5, 20.6% experienced improvements in pain scores. This was the first study to calculate national benchmarks for trauma scene times and traumatic pain management related EMS Compass measures.

164. **Jarvis, J., Wang, HE., Barton, D. Cumulative Success of Prehospital Advanced Airway Management in a National Cohort, in Prehospital Care Research Forum/EMS World & National Association of EMS Physicians. ESO Wave 2018. 2017/2018: Las Vegas & San Diego. Austin.**
The study objective was to characterize cumulative Advanced Airway Management success rates in a national cohort of EMS agencies. Nine years of ESO data were analyzed. There were 61,793 patients that had Advanced Airway Management attempted included in the analysis. Results indicated that first pass prehospital Advanced Airway Management success rates improved from prior studies but were still low. Multiple attempts were common and often unsuccessful.