

60.6 years (SD = 14.3) and they were predominantly male (70.2%) and white (60.1%), with 59.7% presenting to EMS between 06:00 and 18:00. Time of day and race were the two characteristics of patients that varied by the patients presenting location. 77.7% of patients presenting to EMS at a location other than home did so between the hours of 06:00 and 18:00 with only 53.0% of patients presenting at home during the same hours ($p = 0.01$). Further, 80.0% of patients who were classified as a race other than white presented to EMS at home compared to 66.4% of white patients ($p = 0.023$). **Conclusions:** This study indicated that a clear majority of prehospital STEMI patients presented to EMS in the home. Results from this study may further justify educating family members regarding signs and symptoms, and the importance of early EMS activation to help reduce morbidity and mortality.

150. PREVALENCE OF PREHOSPITAL ELECTROCARDIOGRAPH ST-ELEVATION MYOCARDIAL INFARCTION MIMICS

Mary Colleen Bhalla, Jennifer Frey, Jennifer Yee, Christopher Myers, William Hardy, Francis Mencl, Summa Akron City Hospital

Background: Emergency medical services (EMS) are a vital component of rapid identification and transportation of patients with ST-elevation myocardial infarctions (STEMI) for definitive treatment. Such a task may be impeded, however, by ECG rhythms that mimic STEMI, such as left bundle branch blocks (LBBB), right bundle branch blocks (RBBB), ventricular paced rhythms (VP), left ventricular hypertrophy (LVH), and supraventricular tachycardia (SVT). Distinguishing between these rhythms is dependent on provider training. Our objective was to evaluate the prevalence of prehospital ECG STEMI mimics. Knowing this can help guide EMS training and prehospital STEMI team activation protocols. **Methods:** Our setting is a community-based university-affiliated STEMI receiving center hospital with an ED seeing over 77,000 adult patients a year and providing medical direction for more than 21,000 EMS transports a year. ECGs received electronically from EMS are stored in an electronic database. Eight hundred ECGs were randomly selected from the 4,979 ECGs in the 2012 database. We included for analysis the first 600 that were not determined to be unreadable secondary to missing data in one or more leads. The 600 ECGs were examined separately by two emergency medicine physicians for the presence of STEMI, STEMI mimics, or no STEMI/STEMI mimics using rigid diagnostic criteria. We present proportions with 95% confidence intervals (CI). **Results:** Of the 800 ECGs randomly selected, seven were removed because they were duplicates and 19 were unreadable (19/793, 2.4%). Of the 600 ECGs interpreted, 25 STEMI were identified (4.2%; 95% CI, 2.7%-6.1%). Twenty-six percent of the ECGs (155/600 95% CI, 22.4%-29.5%) displayed one of the STEMI mimics: 45 RBBB (7.5%; 95% CI, 5.5%-9.9%), 28 LBBB (4.7%; 95% CI, 3.1%-6.7%), 48 LVH (8.0%; 95% CI, 6.0%-10.5%), 13 SVT (2.2%; 95% CI, 1.2%-3.7%), and 21 VP (3.5%; 95% CI, 2.2%-5.3%). **Conclusions:** In our study population EMS providers were more likely to see STEMI mimics than they were to see STEMI. For our EMS providers to be well trained in STEMI identification they must be taught STEMI mimics as well.

151. SYSTEMATIC REVIEW AND META-ANALYSIS OF THE BENEFITS OF PREHOSPITAL 12-LEAD ECG CONFIRMATION IN STEMI PATIENTS

Julian Nam, Kyla Caners, James Bowen, Michelle Welsford, Daria O'Reilly, PATH Research Institute, McMaster University

Background: Prehospital identification of ST-segment elevation myocardial infarction (STEMI) patients transported by emergency medical services (EMS) with 12-lead electrocardiography (ECG) confirmation can improve patient outcomes. Previous reviews of this strategy showed imprecision and were published prior to the release of a number of newer studies. The objective of this study was to present an updated review of prehospital identification of STEMI patients transported by EMS with 12-lead ECG confirmation versus standard or no cardiac monitoring. **Methods:** EMBASE, PubMed, and Cochrane Library were searched using controlled vocabulary and keywords. Randomized controlled trials and observational studies were included. Outcomes included short-term mortality (≤ 30 days), door-to-balloon/needle time or first medical contact-to-balloon/needle time. Pooled estimates were determined, where appropriate. Results were stratified by percutaneous coronary intervention (PCI) or fibrinolysis. **Results:** The search yielded 1,857 citations of which 68 full-texts were reviewed and 16 studies met the final criteria: 15 included data on PCI and 3 on fibrinolysis (2 included both). Observational studies limited the quality of evidence; however, a number of studies were identified and there were no serious threats of inconsistency, imprecision, or methodological bias that would further downgrade evidence from a low quality. Where PCI was performed, prehospital 12-lead ECG confirmation was associated with a 39% reduction in short-term mortality (8 studies; $n = 6,339$; RR 0.61; 95%CI = 0.42-0.89; $p = 0.01$; $I^2 = 30\%$) compared to standard or no cardiac monitoring. Where fibrinolysis was performed, prehospital 12-lead ECG confirmation was associated with a 29% reduction in short-term mortality (1 study; $n = 17,026$; RR = 0.71; 95%CI = 0.54-0.93; $p = 0.01$). First medical contact-to-balloon, door-to-balloon and door-to-needle times were consistently reduced, though large heterogeneity generally precluded pooling. **Conclusions:** The present study adds to previous reviews by identifying and appraising the strength and quality of a larger body of evidence. Prehospital identification with 12-lead ECG confirmation was found to be associated with reductions in short-term mortality, first medical contact-to-balloon, door-to-balloon and door-to-needle time.

152. IMPLICATIONS OF PREHOSPITAL ELECTROCARDIOGRAM TRANSMISSION AND EMERGENCY DEPARTMENT RECEIPT TIMES ON PREHOSPITAL CARDIAC CATHETERIZATION LAB ACTIVATION

Timothy Lenz, Jeffrey Luk, Matthew Wollerman, Edward Michelson, Medical College of Wisconsin

Background: Chest pain warrants a rapid assessment, including an early 12-lead ECG. Rapid identification of ST elevation myocardial infarctions (STEMIs) or new left bundle branch blocks is of critical importance. Established guidelines emphasize the importance of early STEMI identification and minimization of door-to-balloon (DTB) times. Prehospital identification of STEMI may result in earlier cardiac catheterization lab (CCL) activation. However, meeting first ECG-to-CCL activation time guidelines may be challenging for the emergency department (ED) to comply with when using prehospital ECGs. **Objective:** To study the timeliness of prehospital ECG arrival for review by ED physicians to identify potential delays. Such delays may be inappropriately attributed to the ED when assessing compliance of first ECG-to-CCL activation time of < 5 minutes recommended by the Society of Chest Pain Centers. Design: Retrospective ob-

servational convenience sample. Setting: Urban tertiary academic hospital. Data set: All prehospital ECGs transmitted by 13 EMS agencies through LifeNet Systems™ from January 1, 2013, through June 30, 2013. Protocol: ECGs were reviewed for times obtained and received. The time difference for each ECG was calculated (i.e., obtained to received time (OTRT)). The mean and median OTRTs were found. Average OTRTs were calculated for each agency. **Results:** Out of 1,700 ECGs, 35 had incomplete data and 1 was removed for being an extreme outlier (OTRT 22 hours 58 minutes 51 seconds), resulting in 1,664 ECGs with complete data. Mean and median OTRTs were 5 minutes 54 seconds and 3 minutes 23 seconds, respectively (range 14 seconds to 8 hours 56 minutes 28 seconds). Eleven of the 13 agencies had average OTRTs of no more than 8 minutes 14 seconds. Potential causes for prolonged OTRTs include 1) EMS delay in initiating ECG transmission; 2) network delays in processing; 3) incorrect times due to lack of time synchronization; and 4) delay in recognition of ECG arrival in the ED. **Conclusions:** Printed prehospital ECG times do not accurately reflect the time information becomes available to the ED physician and should not be used as a benchmark for first ECG-to-CCL activation times. Further research should investigate these time delays and focus on methods to reduce transmission delays.

153. THE ENVIRONMENTAL IMPACT OF THE EMS SUPPLY CHAIN

Lawrence Brown, Ian Blanchard, James Cook University, Alberta Health Services Emergency Medical Services

Objective: To estimate the life cycle emissions of U.S. EMS systems, including emissions from supply chain process, and identify the components of the supply chain that contribute most to those emissions. **Methods:** The websites for 200 randomly selected U.S. cities and counties were searched to obtain publicly available EMS budget information for the two most recent budget years. Where line-item budgets were available, the consumer price index was used to convert expenditures to standard year (2002) amounts. Published input-output-based emissions multipliers, accounting for emissions from the upstream and downstream processes associated with any product or service, were then used to calculate "indirect" emissions related to those expenditures. We also calculated the volume of diesel, gasoline, and natural gas consumed by each system (amount spent average price), and used volume-based multipliers to calculate emissions from "direct" energy consumption. "Indirect" and "direct" emissions were summed to calculate life cycle emissions. **Results:** Detailed line-item budgets were available for nine EMS systems located in seven states (population: 7,500 to 400,000; annual response volume: 1,200 to 90,000; average expenditures: $\$50 \pm 20$ per capita, $\$290 \pm 128$ per response). Over 16 total budget years, these EMS systems spent a combined \$94.7 million (in 2002 dollars) and generated 21,877 tons of carbon dioxide equivalent (CO₂e) emissions, or 231 tons CO₂e per \$1 million of expenditure. Total EMS-related life cycle emissions for the U.S. were estimated at 3 million tons CO₂e annually (95% CI: 2.3 to 3.6 million tons CO₂e). The non-energy supply chain contributed 25% of EMS-related life cycle emissions. Purchases of medical supplies and equipment were the largest contributor to supply chain emissions (25%), followed by vehicle purchases/leases (19%) and vehicle maintenance (10%). Other notable contributors were administrative processes (billing, financial and professional services, 10%), office supplies and equipment (8%), and pharmaceuticals and medical gasses (3%). **Conclusions:** Direct emissions,

primarily from vehicle fuel consumption, are the clear priority for EMS sustainability initiatives, but the supply chain accounts for 25% of EMS-related emissions. Reducing waste in the EMS supply chain could have dual benefits of reducing system operational costs and reducing greenhouse gas emissions.

154. EMERGENCY MEDICAL SERVICE SUPER-USER RESOURCE UTILIZATION: THE LOS ANGELES EXPERIENCE

Stephen Sanko, Marc Eckstein, Keck School of Medicine of USC, Los Angeles Fire Department

Background: Overutilization of emergency medical services (EMS) by a select group of "super-users" strains prehospital resources, though few systems have formally reported this. The objective of our study was to quantify the frequency of EMS responses, the resources mobilized, clinical interventions provided, and financial burden that this group represents for a large, urban EMS provider agency. **Methods:** A retrospective review of electronic medical records from the Los Angeles Fire Department (LAFD), the EMS provider for a city of 3.8 million people, was used to identify the 40 most frequent EMS users from July 2011 to June 2012. Outcomes reported included the number of fire department resources deployed for each patient encounter, total resource turnaround time (from time of alarm to being back in service), and the financial debt of each frequent user. **Results:** During the 12 months under study, LAFD providers responded to approximately 336,000 incidents, resulting in 204,900 patient transports. The top 40 EMS "super-users" accounted for 2,359 unique encounters resulting in 2,209 transports, or 1% of all system transports, which included 1,836 single-vehicle and 602 multivehicle dispatches. 37 (92.5%) of the 40 super-users had days in which they required transport by LAFD EMS multiple times. On average, these 37 patients had over 6 days per year (range: 1-32 days) in which they required multiple transports, including one individual with 32 multitransport days. Overall, 2,980 vehicles were involved in care of these patients, including 2,080 BLS and 900 ALS deployments. EMS turnaround time dedicated to these 40 individuals was over 1,540 person-hours, including 540 hours of ALS service. The total charges for these 40 patients over the study period were \$2.4 million, of which \$231,101 was paid. The median balance owed by each of these patients was \$20,232. **Conclusions:** An identified small group of EMS "super-users" places an inordinate demand on our local EMS system. Emergency health-care stakeholders should make efforts to coordinate preventative care and seek alternatives to use of the 9-1-1 system to provide these patients with the help they need while also relieving the EMS system of this burden.

155. THE IMPACT OF LEAN SIX SIGMA METHODOLOGY ON OFFLOAD DELAY IN A CANADIAN EMS SYSTEM

Sheldon Cheskes, Peter Dundas, Mary Ellen Duff, Claudia Mititelu, Oscar Karbi, Kiki Ferrari, Naveed Mohammad, Cindy Hawkswell, Kim Maas O'Hearn, Sunnybrook Centre for Prehospital Medicine, Peel Region Paramedic Service

Background: Emergency department (ED) arrival to transfer of patient care continues to significantly impact paramedic operational costs, ED congestion, and the ability for paramedics to provide emergency coverage in their communities. Lean Six Sigma is a methodology commonly used in industry to simplify system processes and improve efficiency. The objective of this study was to examine the im-

act of Lean Six Sigma strategies on offload delay times in a Canadian EMS system. **Methods:** We conducted a before and after study in a large community hospital ED with historically high offload delay times. Front-line stakeholders, including paramedics, nurses, physicians, and management, participated in the Lean Six Sigma formal approach to process improvement. Key performance metrics and mean offload delay times were collected before (January 1–December 31, 2011) and after (January 1–June 30, 2012) implementation of Lean Six Sigma strategies. **Results:** Mean (SD) offload delay time decreased from 53.5 (56.0) minutes before the Lean Six Sigma intervention to 40.3 (32.1) minutes (delta 13.2 min; 95% CI: 12.1, 14.2; 25% decrease) in the post-implementation phase. Similarly, 90th percentile offload time decreased from 109.3 min to 74.9 min in the after phase (delta 34.4 min; 95% CI: 29.3, 38.6; 31% decrease). Individual components of offload delay that showed the most improvement post implementation of Lean Six Sigma findings were time to transfer of care (51.4 vs. 19.0 min; delta 32.4 min; 63% decrease), time to registration (9.0 vs. 7.0 min; delta 2.0 min; 22% decrease), and time to paramedic ED departure (40.5 vs. 35.3 min; delta 5.2 min; 13% decrease). Based on a mean monthly EMS transport rate of 1,569 patients, process improvements resulted in 344 hours of increased ambulance availability in the community per month. EMS cost savings as a result of process improvements were \$75,336 per month, and \$904,032 per year. **Conclusions:** When employed by EMS agencies and receiving EDs, Lean Six Sigma methodology may result in significant reductions in ambulance offload delay times. Further study is required to determine whether these findings can be sustained over time and replicated in other EMS systems.

156. CHARACTERISTICS OF THE MOST FREQUENT "SUPER-USERS" OF EMERGENCY MEDICAL SERVICES

Stephen Sanko, Marc Eckstein, Keck School of Medicine, Los Angeles Fire Department

Background: A small group of "super-users" account for a disproportionate number of emergency medical service (EMS) encounters and transports. These patients receive more sporadic, uncoordinated care at disparate sites, leading to redundant testing, high system costs, and ultimately ineffective care plans. The objective of our study was to describe the demographic attributes and diversity of transport destinations of the most frequent users in our large urban EMS system. **Methods:** A retrospective review of electronic medical records from the Los Angeles Fire Department (LAFD), the EMS provider for a city of 3.8 million people, identified the 40 most frequent EMS users from July 2011 to June 2012. Patient demographics, living situation, insurance status, and hospital destination information were collected. **Results:** During the 12 months under study, LAFD providers responded to approximately 336,000 incidents, resulting in 204,900 patient transports. The top 40 EMS "super-users" accounted for 2,359 separate EMS incidents, resulting in 2,209 transports (1% of all system transports). The mean age of this group was 51 years (range 35-65). 30 (75%) patients were male, 26 (65%) were identified as homeless, and 22 (55%) had a history of alcohol abuse. 32 (80%) had some form of insurance, including 23 (58%) with Medi-Cal (California Medicaid) and 7 (18%) with Medicare. These 40 patients were transported to 65 area hospitals, and each patient was transported to a mean of 10 different hospitals over the study period (range 3-22). **Conclusions:** A distinct group of "EMS super-users" accounted for an inordinate

number of ambulance transports. These individuals were predominately male, homeless, and alcohol abusers, and the majority of them have some form of health insurance. Efforts should focus on the creation of sobering centers with immediate referral to detoxification programs, and the assignment of these patients to "home" hospitals.

157. INTERFACILITY TRANSPORTS BETWEEN EMERGENCY DEPARTMENTS UTILIZING THE 9-1-1 EMS SYSTEM

Shira Schlesinger, Stephen Sanko, Marc Eckstein, Keck School of Medicine, UCI Medical Center

Background: With increasing development of specialty centers and regionalization of care, emergency physicians (EPs) are often confronted with patients needing definitive care that is unavailable at their hospital. In these cases, the traditional interfacility transport (IFT) is a useful tool; but may also delay care by hours. Since 2007 the City of Los Angeles has implemented a policy permitting IFTs between emergency departments (EDs) via the 9-1-1 EMS system. Any EP may initiate ED-to-ED IFT based on clinical judgment. **Objective:** To determine the frequency and nature of IFTs provided by the local 9-1-1 EMS system and to evaluate the appropriateness of this use of EMS resources. **Methods:** Retrospective review of all paramedic reports for ED-to-ED IFTs between April 2007 and February 2013 in Los Angeles. All IFTs initiated by call to 9-1-1 from an ED and performed by Los Angeles Fire Department paramedics were included. Transferring and receiving hospital, reason for transfer, patient descriptors, and time metrics were captured, including time on scene, response, transport, and turn-around times. **Results:** There were 729 IFTs via 9-1-1 EMS system during the study period, comprising 0.06% of all EMS calls. The most frequent reason for IFT was for transport of patients with ST segment elevation MI (STEMI) to a STEMI center (59.0%, N = 430), followed by major trauma (12.5%, N = 91), and intracranial hemorrhage (8.1%, N = 59) to trauma and neurosurgical centers. Less common reasons included aortic dissection transferred for vascular surgery (4.4%, N = 32), CVA transported to a stroke center (3.7%, N = 27), obstetric emergencies (3.7%, N = 27), and transfers to pediatric critical care facilities (2.7%). Median transport time was 8 minutes (IQR 6-13 minutes) and median turn-around time was 50 minutes (IQR 39-67 minutes). All IFTs involved a potentially life-threatening condition, requiring a higher level of care than was available at the referring hospital. **Conclusions:** Emergency IFTs via 9-1-1 contact are an infrequent but appropriate use of local EMS resources that increase speed of transfer to definitive care. With an increase in the designation of specialty centers, EMS providers should have procedures in place to handle these requests.

158. THE OFFLOAD ZONE AS A SOLUTION TO EMERGENCY MEDICAL SERVICES (EMS) OFFLOAD DELAY IN THE EMERGENCY DEPARTMENT: A PROCESS MAP AND HAZARD ANALYSIS

Alix Carter, James Gould, Peter Vanberkel, Jan Jensen, Jolene Cook, Steven Carrigan, Mark Wheatley, Andrew Travers, EHS Nova Scotia, Dalhousie University

Background: Offload delay is a prolongation of the interval between ambulance arrival in emergency department (ED) and transfer of patient care. This reduces the availability of ambulances for emergency response in the community. The offload zone (OZ), which can receive multiple ambulance patients waiting for an ED bed, has been implemented as a