

LO30**Optimizing diagnostic testing processes to improve emergency department throughput: a systematic review**

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Introduction: Emergency Department (ED) crowding is an intensifying crisis. While input, throughput, and output factors all contribute to crowding, throughput factors are the most dependent on ED staff and process. Diagnostic testing is a fundamental ED process that has not been systematically evaluated. We present a systematic review of interventions designed to reduce ED length of stay (LOS) by optimizing laboratory or imaging turnaround time, or by introducing point-of-care testing (POCT). **Methods:** We conducted systematic database searches in Medline, Embase, CINAHL, and the Cochrane Central Register of Controlled Trials without filters or language restrictions, of all interventions on diagnostic technology that affected ED throughput (PROSPERO:CRD42019125651). Studies were screened by two independent reviewers. Study quality was assessed using the Cochrane ROB-2 tools for randomized controlled trials (RCTs), and the National Heart, Lung, and Blood Institute tool for all other study designs. **Results:** 18 studies met inclusion criteria (Cohen's kappa = 0.69). Study results were not pooled due to high statistical heterogeneity as assessed by chi-squared and I-squared statistics. 12 POCT intervention studies reported LOS changes ranging from -114 to +8 minutes (-26.8% to +3.8%), although three were non-significant findings. Four studies that initiated POCT or lab-ordering at triage reported LOS reductions ranging from 22 to 174 minutes, but only one of these, at 29 minutes (16%), was statistically significant. One study of improved laboratory troponin processing reported a LOS reduction of 43 minutes (12.3%). Another, which allowed triage nurses to order ankle x-rays using the Ottawa ankle rules, reported a non-significant LOS reduction of 28 minutes for patients with ankle injuries. LOS improvements reflected the population of patients who underwent the testing modality, rather than overall ED LOS. Seven studies had low risk of bias, 11 studies had some risk of bias, and no studies had high risk of bias (Cohen's kappa = 0.58). **Conclusion:** Eleven of 18 diagnostic testing studies reported LOS reductions. POCT was the most common intervention type, and usually reduced EDLOS within relevant patient subsets, while triage-initiated testing generally did not. To aid widespread adoption, future research should focus on interrupted time series or RCT designs, and more comprehensive descriptions of the contextual factors affecting implementation of these interventions.

Keywords: crowding, point-of-care testing, throughput

LO31**Triage drift: Variation in application of the Canadian Triage Acuity Scale between triage nurses compared to triage paramedics in response to overcrowding pressures in an emergency department**

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Introduction: CTAS is a validated five-level triage score utilized in EDs across Canada and internationally. Moderate interrater reliability between prehospital paramedic and triage nurse application of CTAS during clinical practice has been found. This study is the first assessment of the variation in distribution of CTAS scores with increasing departmental pressure as measured by the NEDOCs scale comparing triage allocations made by triage nurses with those made by triage

paramedics. **Methods:** We conducted a retrospective, observational cohort study of EDIS data of all patients triaged in the Halifax Infirm-ary Emergency Department from January 1, 2017-May 30, 2017 and January 1, 2018 - May 30, 2018. CTAS score assignment by nursing and paramedic triage staff were compared with increasing levels of ED overcrowding, as determined by the department NEDOCs score. **Results:** Nurses were more likely to assign higher acuity scores in all situations of department crowding; there was a 3% increased probability that a nurse, as compared to a paramedic, would triage as emergent when the ED was not overcrowded (Pearson chi-square (1) = 4.21, $p < 0.05$, Cramer's $v = 0.028$, $n = 5314$), and a 10% increased probability that a nurse, as compared to a paramedic, would triage a patient as emergent when EDs were overcrowded (Pearson chi-square(1) = 623.83, $p < 0.001$, Cramer's $v = 0.11$, $n = 56\ 018$). **Conclusion:** Increasing levels of ED overcrowding influence triage nurse CTAS score assignment towards higher acuity to a greater degree than scores assigned by triage paramedics.

Keywords: allied health personnel, Canadian Triage and Acuity Scale, triage

LO32**Artificial intelligence to predict disposition to improve flow in the emergency department**

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Introduction: Emergency department (ED) crowding is a major problem across Canada. We studied the ability of artificial intelligence methods to improve patient flow through the ED by predicting patient disposition using information available at triage and shortly after patients' arrival in the ED. **Methods:** This retrospective study included all visits to an urban, academic, adult ED between May 2012 and June 2019. For each visit, 489 variables were extracted including triage data that had been collected for use in the Canadian Triage Assessment Scale (CTAS) and information regarding laboratory tests, radiological tests, consultations and admissions. A training set consisting of all visits from April 2012 up to December 2018 was used to train 5 classes of machine learning models to predict admission to the hospital from the ED. The models were trained to predict admission at the time of the patient's arrival in the ED and every 30 minutes after arrival until 6 hours into their ED stay. The performance of models was compared using the area under the ROC curve (AUC) on a test set consisting of all visits from January 2019 to June 2019. **Results:** The study included 536,332 visits and the admission rate was 15.0%. Gradient boosting models generally outperformed other machine learning models. A gradient boosting model using all available data at 2 hours after patient arrival in the ED yielded a test set AUC 0.92 [95% CI 0.91-0.93], while a model using only data available at triage yielded an AUC 0.90 [95% CI 0.89-0.91]. The quality of predictions generally improved as predictions were made later in the patient's ED stay leading to an AUC 0.95 [95% CI 0.93-0.96] at 6 hours after arrival. A gradient boosting model with 20 variables available at 2 hours after patient arrival in the ED yielded an AUC 0.91 [95% CI 0.89-0.93]. A gradient boosting model that makes predictions at 2 hours after arrival in ED using only variables that are available at all EDs in the province of Quebec yielded an AUC 0.91 [95% 0.89-0.92]. **Conclusion:** Machine learning can predict admission to a hospital from the ED using variables that area collected as part of

routine ED care. Machine learning tools may potentially be used to help ED physicians to make faster and more appropriate disposition decisions, to decrease unnecessary testing and alleviate ED crowding. **Keywords:** artificial intelligence, emergency department crowding, emergency department disposition

LO33

Sharing and teaching electrocardiograms to minimize infarction
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Background: Every 30-minute delay to ST-Elevation Myocardial Infarction (STEMI) reperfusion increases one-year mortality by 7.5%. A local audit found that the third of patient electrocardiograms (ECGs) not initially meeting classic STEMI criteria had an ECG-to-Activation (ETA) time of over 90 minutes, more than five times that of classic STEMI. However, three quarters of “STEMI negative” ECGs met STEMI-equivalent patterns or rules for subtle occlusion, uncovering an opportunity for improvement. **Aim Statement:** We aimed to reduce ETA time, from initial emergency department (ED) ECG to activation of the cath lab, for patients whose ECGs did not meet classic STEMI criteria, by 30 minutes within one year (i.e. by Dec 2019). **Measures & Design:** We reviewed all ED Code STEMI over a 35-month pre-intervention period. Root Cause analyses, including Ishikawa diagram and Pareto chart, led to our Plan-Do-Study-Act cycles: 1) a survey to engage our team; 2) a Grand Rounds presentation as an educational strategy; and 3) weekly web-based feedback to all ED physicians on STEMI-equivalents and subtle occlusions, using recent local cases. Our outcome measures were ETA times, stratified by ECGs not initially meeting STEMI criteria (primary) and those that did (secondary). Our process measures were the number of website visits and page views. Our balancing measure was the proportion of Code STEMI without culprit lesion. We used Statistical Process Control (SPC) charts with usual special cause variation rules. **Evaluation/Results:** ETA time for the 37.5% of 56 ECGs that did not meet classic STEMI criteria decreased from 97.5 to 53.7 minutes (min), a 43.8-min absolute decrease ($p = 0.037$), while those meeting STEMI criteria remained the same (16.5 to 18.2min, $p = 0.75$). SPC charts did not show special cause variation. There were 2,634 page views (65.9/week) and 1,092 visits (27.3/week), in a group of 80 physicians—i.e. a third of the group each week. There was no change in Code STEMI without culprit lesions (28.0% to 23.3%, $p = 0.41$). **Discussion/Impact:** We reduced ETA time by 43.8min for the one third of patients with culprit lesions not initially meeting classic STEMI criteria, a magnitude associated with mortality impact. To do so, we used a multi-modal educational strategy including a novel web-based feedback approach to all ED physicians. Local feedback and education on this challenging-to-diagnose subgroup, guided by ETA time as a quality metric, could be replicated in other centres.

Keywords: electrocardiogram, quality improvement and patient safety, ST elevation myocardial infarction

LO35

A province-wide quality improvement collaborative for treatment of children’s pain in Alberta’s emergency departments
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Background: Pediatric pain is often under-treated in emergency departments (EDs), causing short and long-term harm. In Alberta EDs, children’s pain outcomes were unknown. A recent quality improvement collaborative (QIC) led by our team improved children’s pain care in 4 urban EDs. We then spread to all EDs in Alberta using the Institute for Healthcare Improvement Framework for Going to Full Scale. **Aim Statement:** To increase the proportion of children <12 years who receive topical anesthetic before needle procedures from 11% to 50%; and for children <17 years with fractures: to 1) increase the proportion receiving analgesia from 31% to 50%; 2) increase the proportion with pain score documentation from 24% to 50%, and 3) reduce time to analgesia from 60 to 30 minutes, within 1 year. **Measures & Design:** All 97 EDs in Alberta that treat children were invited. Each was asked to form a project team, attend webinars, develop key driver diagrams and perform PDSA tests of change. Sites were given a monthly list of randomly selected charts for audit and entered data in REDCap for upload to a provincial run chart dashboard. Baseline performance measurement informed aims. Measures included proportion of children <12 years undergoing a lab test who received topical anesthetic, and for children <17 years with fracture, the proportion with a pain score, proportion receiving analgesia and median minutes to analgesia. Length of stay and use of opioids were balancing measures. Control charts were used to detect special cause. Interrupted time series (ITS) was performed to assess significance and trends. **Evaluation/Results:** 36 sites (37%) participated, including rural and urban sites from all regions. 8417 visits were audited. 23/36 sites completed audits before and after tests of change and were analyzed. Special cause occurred for all aims. The proportion receiving topical anesthetic increased from 11% to 30% (ITS $p < 0.001$). For children with fractures, the proportion with pain scores increased from 24% to 34% (ITS $p = 0.21$, underlying trend present), proportion receiving analgesic medication increased from 31% to 39% (ITS $p = 0.41$, underlying trend present) and minutes to analgesia decreased from 60 to 28 (ITS $p < 0.01$). There was no increase in length of stay or use of opioid medications. **Discussion/Impact:** A pragmatic approach encouraging locally led change was well-received and key to success. The QIC method shows promise for improving outcomes in diverse EDs across large geographic areas. Next steps include further spread and sustainability measurement.

Keywords: pain, pediatric, quality improvement and patient safety

LO36

Reducing emergency department bloodwork and eliminating waste

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Background: Patients presenting to the Emergency Department (ED) may be subjected to unnecessary bloodwork. This leads to excessive work for front-line nurses, physicians and laboratory staff, contributing to increased ED length of stay (LOS), patient discomfort, and health care costs. **Aim Statement:** By January 1, 2020, we will reduce the number of targeted blood tests (AST, GGT, aPTT and CK) by 40% in the Mount Sinai ED, as measured by the percent per 1000 ED visits of AST to ALT, GGT to ALT, aPTT to INR and CK to troponin. **Measures & Design:** This was a prospective time series quality improvement study. Using the Model for Improvement, we engaged front-line ED staff, as well as stakeholders from