levels with manual palpation. At completion of the study, participants reported higher confidence levels as measured by the VAS with US (91mm (IQR 82-97) vs 83mm (IQR 72-94), p<0.001).

The authors concluded that pulse checks using ultrasound were not slower than with manual palpation. They felt using ultrasound produced more consistent results and led to a higher first attempt success rate compared with palpation. Despite participants feeling less comfortable with ultrasound initially, after a brief training course, they reported higher confidence levels with US as compared to manual palpation. One advantage of this study was that it included multiple different health professions, which makes it generalizable to a broader population. The authors did note this study was limited by the fact that pulse checks were performed on live, non-bradycardic participants. Pulse checks potentially would take longer in bradycardic patients. There were also questions as to whether these results would hold true in a cardiac arrest, but authors hypothesize that the benefit of POCUS would be even greater in cardiac arrest, due to pulse checks during arrest being unreliable. POCUS remains a promising alternative to manual pulse checks in cardiac arrest.

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☐ APPLICATION OF HIGH-SENSITIVITY TROPONIN IN SUSPECTED MYOCARDIAL INFARCTION.

Neumann JT, Twerenbold R, Ojeda F, et al. *The New England Journal of Medicine* 2019;380:2529-40

Chest pain is universally a leading cause of emergency department visits. Technological advancements have led to the development of high-sensitivity troponin assays. The application, interpretation, and appropriate utilization of their results is still under investigation. Furthermore, the increased sensitivity of these assays raises additional challenges such as determination of true myocardial infarction (MI) versus other causes of myocardial injury, appropriate timing of serial troponin sampling (i.e., from 1 to 6 hours), and prognostic implications of persistently elevated troponin levels. This study sought to develop a calculator capable of identifying the probability of acute MI (AMI) and 30-day outcomes, as well as provide prognostic information on patients identified as not having a myocardial infarction.

The study used data from 15 international cohorts consisting of 23,327 prospectively enrolled patients with suspected myocardial infarction. After exclusion of patients with ST-segment elevation myocardial infarction, 22,651 patients remained for analysis. A derivation data set was derived using 9,604 patients and the remaining 13,047 patients were used for validation of the results. Patients were assigned as either low or high risk based on high sensitivity troponin concentrations at presentation (C1, nanograms per liter) and absolute changes on serial sampling (C2, nanograms per liter). Authors calculated the negative predictive value (NPV), sensitivity, positive predictive value (PPV), and specificity for a variety of combinations of C1 and C2. Using the derivation data set, they were able to evaluate diagnostic performance of various combinations. Results were further examined using the validation data set. Long-term prognostic data was calculated by comparing high-sensitivity troponin values of patients without myocardial infraction to the general population. Patients were matched in a 1:1 ratio using various patient demographics. Using Cox regression analysis, risk of myocardial infarction and death at follow-up were estimated. Median follow up time of the study population was 730 days and 8 years in the general population.

A total of 3,455 (15.3%) of patients in the study population were diagnosed with myocardial infarction. Low high-sensitivity troponin and small changes on serial sampling were associated with high NPV for myocardial infarction and NPV decreased as the initial troponin and absolute changes in serial troponin concentration increased. Conversely, PPV was greater with elevated high-sensitivity troponin concentrations and large absolute changes on serial sampling while PPV decreased as concentrations and absolute changes decreased. Authors classified patients into low risk groups (NPV 100-99.5%, 99.4-99.0%, 98.9-98% and 97.9-97%) and high-risk groups (PPV 80.0% and higher, 79.9-75%, 74.9-70% and 69.9-65%). They provide an interactive calculator at www.compass-mi.com for classification of patients into appropriate groups. In regards to prognostic data, death or myocardial infarction occurred in 3.9% of patients at 1 year and 6.3% at 2 years of the acute study population compared to general population rates of 1% and 2.6% at 1 and 2 years, respectively. Overall risk of myocardial infarction or death in patients presenting to the ED with high-sensitivity troponin I > 10-14 ng/L but diagnosed as not having acute myocardial infraction was 4.8% and 8.1% at 1 and 2 years, respectively, while risk in the general population was 1.4% at 1 year and 3.4% at 2 years.

Authors derived and validated a risk assessment tool, titled The Calculation of Myocardial Infarction Risk Probabilities to Manage Patients with Suspicion of Myocardial Infarction (COMPASS-MI) project, for evaluation of patients with suspected myocardial infarction using high-sensitivity troponin assays. The authors state this tool can risk stratify patients into low -and high-risk groups based on initial troponin and dynamic changes. Such stratification may help identify patients appropriate for discharge versus those at high risk of myocardial infarction or death. Patients identified as neither low- nor high-risk would require further evaluation. Elevated high-sensitivity troponin may provide prognostic information as well since there was a strong correlation with myocardial infarction or death in both study participants diagnosed as not having myocardial infarction and in the general population comparison group. The authors noted limitations, including non-standardized methodology of diagnosis of myocardial infarction between cohorts, heterogenous study populations, potential variability between troponin T and troponin I assays, and use of samples stored for up to two decades to derive general population data.

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Comment: This study provides additional information on appropriate interpretation and utilization of high-sensitivity troponin assays. Simply, it helps us answer the question: at a given initial and subsequent troponin value, what are the chances that our patient will have an acute myocardial infarction within 30 days? The tool derived appears to be a relatively simple to use method of risk stratification based entirely on objective data. Further external validation studies are needed to verify results. Additionally, studies comparing this tool to currently validated methods of risk stratification could prove beneficial.

☐ CHRONIC USE OF TRAMADOL AFTER ACUTE PAIN EPISODE: COHORT STUDY.

Thiels CA, Habermann EB, Hooten WM, Jeffery MM
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Tramadol has traditionally been thought to be less habit forming with fewer side effects than other short acting opioids. Recent studies, however, have suggested that tramadol may actually have an increased risk for long-term abuse.

The aim of this observational, retrospective study was to determine the risk for long-term use of opioids after the use of tramadol for acute pain post operatively compared to other opiate medications. This study evaluated post-operative (post-op) opiate prescriptions from an insurance database that included both privately insured and Medicare patients from January 1, 2009 to June 30, 2018. Opioid naive adults who were discharged with an opioid prescription after undergoing elective surgery and enrolled in the insurance 6 months prior to the surgery were included in the study. A wide range of elective surgeries was included, such as cholecystectomies, inguinal hernia repair, orthopedic procedures, and hysterectomies with the goal to provide a diverse spectrum of procedures with different expected levels of post-op pain. Exclusion criteria was having an opiate prescription filled in the 6 months before surgery, inpatient stay >1 day pre-op or >7 days post-op, having more than one surgery, having a non-cancer surgery in a patient with cancer, enrolled in hospice care, discharge to a nursing facility, or disenrollment in the insurance within 90 days post-op. The prescriptions were categorized into five groups: no opioid fill, tramadol only, other short acting opioids, other short acting opioids plus tramadol, or long acting opioids. The outcome of long-term opioid use was categorized into three groups: additional use after surgery (opioid refill within 90-180 days post-op), persistent use after surgery (any opioid use within 180 days post-op and continued for at least 90 days), or long term opiate use as defined by the CONSORT definition (any opioid use within 180 days and continued for at least 90 days with either at least 10 opioid fills or at least 120 day opioid supply).

There were 444,764 patients that met the inclusion criteria, of which 357,884 patients were discharged with opioid prescriptions. Most common prescriptions were short acting opioids other than tramadol (74.9%), no opioid fill (19.5%), tramadol (3%), long acting opioid (1.3%), and short acting opioids plus tramadol (1.2%). The average amount of opioids prescribed in morphine milligram equivalents (MME) was 225, which is equivalent to 45 tablets of 5 mg hydrocodone or 30 tablets of 5 mg oxycodone. The adjusted risk ratio for additional opioid use, using short acting opioids other than tramadol for reference, demonstrated 1.06 (95% CI 1.0 to 1.13) risk with tramadol alone and 1.05 (95% CI 0.96 to 1.14) risk for tramadol plus another short acting opioid. The adjusted risk ratio for persistent opioid showed an adjusted risk ratio of 1.47 (95% CI 1.25 to 1.69) risk for tramadol alone and 1.04 (95% CI 0.86 to 1.21) risk for tramadol plus another short acting opioid. The adjusted risk ratio for long term opiate use by the CONSORT definition showed a 1.41 (95% CI 1.08 to 1.75) risk for tramadol alone and 1.40 (95% CI 1.05 to 1.74) risk for tramadol plus another short acting opioid. Limitations of this study include inability to know actual opioid use since it only evaluated prescriptions filled, inability to generalize findings outside of privately insured and Medicare patients undergoing elective surgery, and inability to ascertain reasons patients may have received additional opioid prescriptions.

The authors concluded that tramadol has similar risk, if not higher, for the development of long term opioid use and should be used with caution for management of pain, similar to other opiates.

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Comment: This study suggests that a similar or higher risk exists for long-term opiate use if patients receive tramadol for post-operative pain rather than other short-term opiates. Selection bias does limit the validity of these results but this does reiterate that we should be cautious when prescribing all opioids, including tramadol. A prospective study, ideally a randomized trial, would be needed to shed further light on this topic.