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OBJECTIVES:

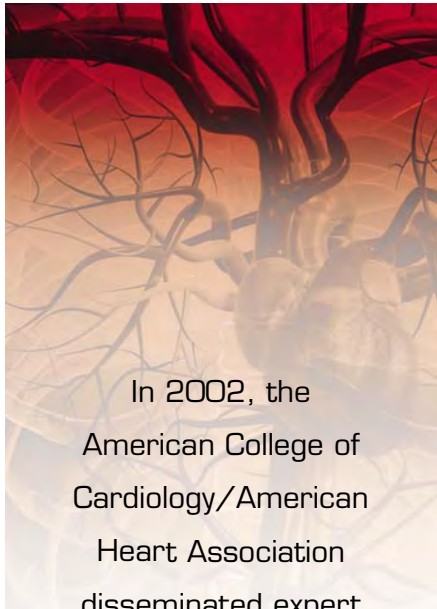
1. Describe the CRUSADE quality improvement initiative.
2. Using data from CRUSADE, describe the changes in acute care practice patterns that have occurred during the last four years.
3. Define potential areas of quality improvement directly related to emergency department care for non-ST-segment elevation acute coronary syndrome.

INTRODUCTION

The recognition and treatment of a patient with an acute coronary syndrome (ACS) are critical components of the evaluation of the patient with a complaint of chest pain by the emergency physician. Once a patient has been identified as having ACS, the treatment of these individuals traditionally has been based on local practices with generalized adoption of the use of aspirin and beta-blockers. In 2002, the American College of Cardiology/American Heart Association disseminated expert recommendations for the management of patients with non-ST-segment elevation myocardial infarction (NSTEMI) ACS.¹ These recommendations encompass the entire course of care for a patient with NSTEMI ACS beginning in the pre-hospital setting.

Despite multiple iterations of these guidelines, routine adaptation into general clinical practice has not occurred. In an effort to stimulate better adherence to practice guidelines and improve the quality of care for patients with NSTEMI ACS, the CRUSADE (Can Rapid Risk Stratification of Unstable Angina

Patients Suppress ADverse Outcomes with Early Implementation of the ACC/AHA Guidelines) quality improvement and educational initiative was developed. This program serves as an NSTEMI ACS registry and provides an innovative and multifaceted approach to the education of emergency physicians and cardiologists in the care of these patients. The CRUSADE quality improvement initiative is a multidisciplinary cooperative effort involving over 400 emergency departments (EDs) and medical centers across the United States. CRUSADE includes a registry of patients who meet diagnostic criteria for high-risk NSTEMI ACS (positive cardiac markers, ST-segment depression, or transient ST-segment elevation). It was designed to characterize demographic patterns and risk stratification results. Embedded in this registry are mechanisms to measure the use of ED treatment modalities including aspirin, heparin, beta-blockers, and platelet inhibitors as recommended in the ACC/AHA guidelines. Along with an education program, each participating institution is given a report of their own



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treatment patterns. This initiative represents a truly innovative approach to improving care for ACS patients in the ED as well as on the cardiology service, recognizing that the care of patients with NSTEMI ACS is a continuum that begins in the ED and persists throughout the hospital course. This article describes the CRUSADE quality improvement initiative, its implications for the practicing emergency physician, and how to further identify areas for NSTEMI ACS care requiring improvement.

CRUSADE Quality Improvement Initiative

The CRUSADE NSTEMI ACS registry includes patients who are prospectively identified in the ED as well as those who are retrospectively identified by discharge diagnosis or procedural logs. Patient inclusion criteria include 1) chest pain or anginal equivalent at rest, at least 10 minutes in duration and occurring less than 24 hours prior to presentation; 2) ischemic electrocardiogram (ECG) changes (ST-segment depression or transient ST-segment elevation); or 3) elevated levels of biomarkers of myocardial necrosis (creatinine kinase-MB or troponin) above baseline levels. Patients transferred into participating hospitals must arrive within 24 hours of their symptom onset to be eligible.

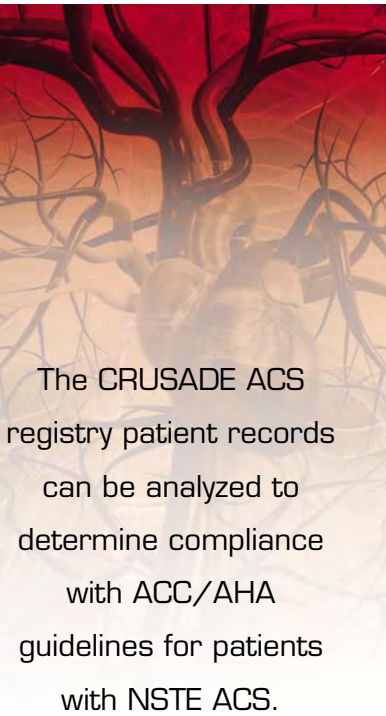
The CRUSADE ACS registry patient records can be analyzed to determine compliance with ACC/AHA guidelines for patients with NSTEMI ACS. The data points for acute therapy include treatment with aspirin, beta-blockers, heparin, glycoprotein IIb/IIIa inhibitors, as well as clopidogrel. Timing of therapies is documented in order to differentiate ED utilization from in-hospital downstream interventions. Contraindications for medication administration must be documented if not administered and the time frame identified for acute medication administration is 24 hours after ED presentation. Risk stratification criteria such as ECG and biomarker results are established for each patient. Patients are followed through their hospitalization course to determine outcomes.

Practice Patterns

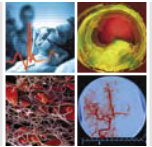
The CRUSADE quality improvement initiative is currently in its 5th year of data collection and education. As a result of this, the temporal changes in treatment patterns can be compared. When compared to clinical trials, patients enrolled in the CRUSADE quality improvement initiative are older, more often diabetic, female, have had a myocardial infarction, have a history of heart failure, and have undergone a PCI or CABG (Table 1).^{2,4} In addition, the in-hospital mortality rate (4.5%) is double that of clinical trials with similar entry criteria (Figure 1).^{2,3} This difference exhibited between patients enrolled in randomized clinical trials and those in the CRUSADE population has persisted over the last four years.⁴

Over the past 4 years there has been dramatic increase in the use of guideline recommended therapies.⁴ The increase in the use of acute medications includes a large increase in the percentage of patients receiving aspirin, beta-blockers, and heparin which are traditionally administered in the ED (Table 2). There has also been a decrease in the time from presentation to cardiac catheterization and coronary intervention. This accompanies a higher percentage of patients undergoing coronary catheterization (Table 3).

Although quality improvement initiatives are an integral part of the health care system, the success of these programs should be measured by their ability to change care coupled with evidence of improved outcome that accompanies this change. Using the CRUSADE registry, Peterson et al. showed that composite guideline adherence rates were significantly associated with in-hospital mortality. Observed mortality rates decreased from 6.31% in the hospitals with the lowest



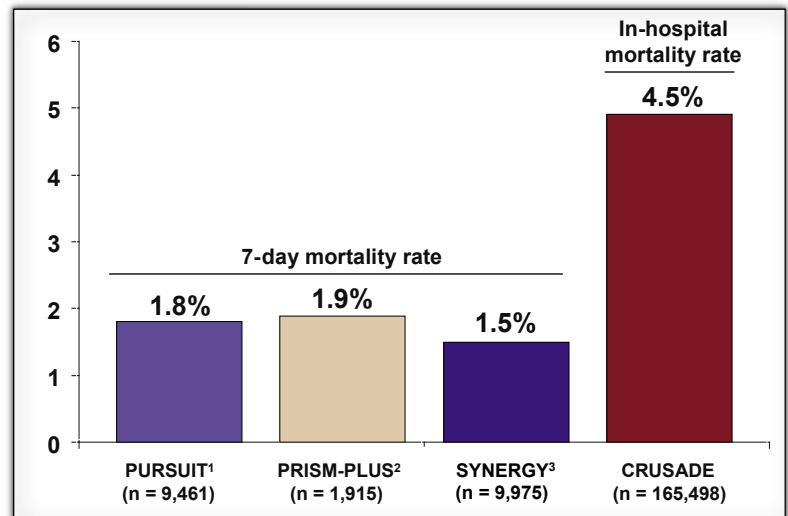
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Variable	PURSUIT (n = 9461)	CURE (n = 12,562)	SYNERGY (n = 9975)	CRUSADE (n = 165,498)
Mean age ± SD (yrs)	63 ± 11	63 ± 12	67 ± 11	67 ± 14
Female sex (%)	36	39	34	40
Diabetes mellitus (%)	23	23	29	33
Prior MI (%)	32	25	28	30
Prior CHF (%)	11	8	9	18
Prior PCI (%)	13	18*	20	21
Prior CABG (%)	12	18*	17	19
ST depression (%)	50	42	55	35

Table 1. Baseline characteristics for patients enrolled in three randomized clinical trials and CRUSADE.

Figure 1. In-hospital mortality rate in three randomized clinical trials versus CRUSADE. 1: The PURSUIT Trial Investigators, N Engl J; Med 1998; 2: The PRISM-PLUS Study Investigators, N Engl J Med 1998; 3: The Synergy Study JAMA 2004; 4: CRUSADE cumulative data: (through 12/31/2005)



Medication	2002	2006
Aspirin	90%	96%
Beta-blocker	76%	91%
Heparin	83%	87%
Glycoprotein IIb/IIIa inhibitor	32%	45%

Table 2. Acute treatment changes for therapies administered in the first 24 hours for patients with NSTEMI ACS. Adapted from National Data Reports (www.crusadeqi.com).

Table 3. Changes in time to procedure for patients with NSTEMI ACS. Adapted from National Data Reports (www.crusadeqi.com). PCI: percutaneous coronary intervention, CABG: coronary artery bypass grafting.

Procedure	2002		2006	
	%	Hours (95% CI)	%	Hours (95% CI)
Cath	67%	32 (16,59)	83%	23.3
PCI	36%	28 (14,58)	63%	21.6
CABG	11%	86 (46,122)	11%	68.6

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compliance rate to 4.15% for the highest compliance rate ($P<.001$) when the adherence scores were stratified into quartiles. After risk adjustment, every 10% increase in composite adherence at a hospital was associated with an analogous 10% decrease in its patients' likelihood of in-hospital mortality (adjusted odds ratio, 0.90, 95% CI 0.84–0.97; $P<.001$) (Figure 2).⁵ Although these results were a composite of adherence to acute and chronic medications, similar trends were seen when acute medications were evaluated independently.

The trends noted in improved adherence coupled with the association of improved outcome are a credit to the effort of all the participants in the CRUSADE registry. These results show that collaboration, education, and continuous feedback with hospital administrators and health care providers can improve the care of patients with NSTEMI ACS.

Special Populations

Along with providing educational materials and regular feedback to the participating hospitals, the CRUSADE project has created a robust registry that

is being used to further the understanding of the management for patients with NSTEMI-ACS. Importantly, the CRUSADE registry has collected data points that enable analysis of parameters of clinical importance to the emergency physician. Manuscripts have addressed critical areas of disparity in acute treatment,⁶⁻¹² outcomes associated with diagnostic tests performed in the ED settings,¹³⁻¹⁷ and potential areas where practice patterns can improve.^{18,19}

Disparity in Care

Using the CRUSADE registry, differences in acute management of special populations have been analyzed. Blomkalns et al. evaluated the impact of gender on adhering to guideline-based treatment recommendations.⁷ Women were treated less aggressively than men in the administration of these acute medications - heparin, angiotensin-converting enzyme inhibitors, and glycoprotein IIb/IIIa inhibitors. In addition, women were less likely to undergo cardiac catheterization than men. Despite the difference in the acute treatment of women, there was no difference in the outcomes of death and re-infarction after adjustment for confounders.⁷ In a separate analysis, difference in the treatment by patient age was evaluated. It was reported that the use of anti-thrombin and anti-platelet drugs decreased as age increased. The rate of cardiac catheterization also decreased as age increased. These reductions in therapy use were associated with an increased rate of death and re-infarction with increasing age.⁶

The impact of patient race on ACS care was also evaluated. Data from

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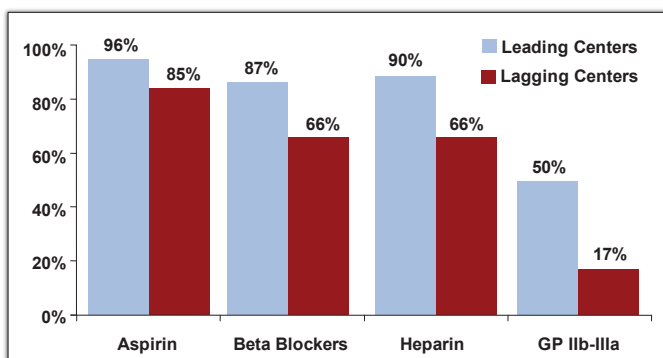
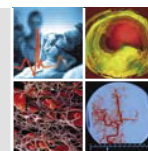


Figure 2. Comparison of guideline adherence for hospitals for acute medication use: Leading and lagging hospitals over first 24 hours.



CRUSADE have indicated that acute treatment varies by race.^{10,12} Black patients had a similar or higher likelihood than whites of receiving ACS treatments such as aspirin, beta-blockers, or ACE inhibitors but were significantly less likely to receive newer ACS therapies, including glycoprotein IIb/IIIa inhibitors and clopidogrel. Blacks were also less likely to receive cardiac catheterization or revascularization procedures. Despite difference in acute therapy there was no difference for in-hospital outcomes in black patients with NSTEMI ACS.¹⁰ Hispanics were noted to be managed more conservatively than whites. They were shown to undergo stress tests more frequently (13.0% vs 10.1%, $P < .0001$), and have less use of cardiac catheterization within 48 hours (48.7% vs 55.5%, $P < .0001$).¹²

Clinical Practice

In addition to evaluating treatment disparity by specific patient populations, data from the CRUSADE registry have been used to address pertinent clinical questions ranging from diagnosis of ACS to current treatment practice. In the clinical setting, it is difficult to interpret discrepant results between creatine kinase-MB (CK-MB) and cardiac troponin (cTn) levels. Newby et al evaluated the risk of in-hospital mortality by troponin and CK-MB status.¹⁵ In-hospital mortality was 2.7% among CK-MB-/cTn- patients; 3.0%, CK-MB+/cTn-; 4.5%, CK-MB-/cTn+; and 5.9%, CK-MB+/cTn+. After adjustment for other presenting risk factors, in-hospital death was highest in patients who were troponin positive. The authors concluded that an elevated troponin level identifies patients at increased acute risk regardless of CK-MB status, but an isolated CK-MB+ status still has some prognostic value.¹⁵

Morphine has been traditionally used for the management of persistent pain in patients with cardiac related chest pain. Although never extensively studied, the use of morphine has become part of the standard therapy approach for patients with chest pain. In an analysis of the CRUSADE registry, morphine used either alone or in combination with nitroglycerin for patients presenting with NSTEMI ACS was associated with higher mortality even after risk adjustment and matching for propensity score for treatment. This analysis can not show a direct correlation

with adverse events, but raises concerns regarding the safety of using morphine for these patients and emphasizes the need for a randomized trial evaluating the use of morphine in the NSTEMI ACS population.¹⁴ Without data from a large observation registry such as CRUSADE it is doubtful that an association between morphine and in-hospital mortality would have been discovered.

Areas for Improvement

The CRUSADE registry has also identified areas of clinical care that warrant further evaluation. Specifically, the registry has helped identify the process of care issues that are related to outcome in patients with NSTEMI ACS.^{18,19} While patients with NSTEMI ACS are typically admitted promptly after diagnosis, under conditions of ED or hospital overcrowding these patients may have prolonged ED stays. This can occur as the patient waits for transfer to an inpatient unit or to the cardiac catheterization laboratory. These patients continue to require ongoing evaluation and treatment. Under such conditions, it is possible for these patients to be less closely monitored or treated less aggressively as ED staff attention is diverted to the triage and treatment of new acute patients. Data from the CRUSADE registry suggest that patients who stay in the ED longer than usual for a given institution are less likely to receive guideline driven therapy for NSTEMI ACS and have worse in-hospital clinical outcomes than those patients who stay in the ED an the average length of stay.¹⁸

Another area of clinical importance is a potential for medication dosing errors in patients with NSTEMI ACS. The recommendations for acute treatment with anti-platelet and anti-thrombin drugs require specific dosing based on weight and creatinine clearance. The complexity of the dosing of these agents led to 42% of the patients receiving an excess dose of one of these drugs. Factors associated with excess dosing included older age, female sex, renal insufficiency, low body weight, diabetes mellitus, and congestive heart failure. Relative to those patients not administered excess dosages, patients with excess dosages of unfractionated heparin, low molecular weight heparin, and glycoprotein IIb/IIIa inhibitors tended toward higher risks for major bleeding (adjusted odds ratio [OR], 1.08; 95% confidence interval [CI], 0.94-1.26; OR, 1.39;

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95% CI, 1.11-1.74; and OR, 1.36; 95% CI, 1.10-1.68; respectively). Mortality and length of stay were higher among those patients with excess drug doses. Both of these studies have identified areas that can be improved by focused education and protocol-driven care.¹⁹

SUMMARY

The CRUSADE quality improvement initiative has led to improve adherence to guideline recommended therapies. Through educational efforts, direct feedback, and a mechanism to foster collaboration between specialties at member hospitals, care for patients with NSTEMI ACS can be improved, with better outcomes. Data collected from this registry have also provided insight on the disparities of care and challenges to current practice patterns. Through the use of registries such as CRUSADE for NSTEMI ACS, consistent guideline-based therapies can be delivered for our patients with improved outcomes.

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