OPEN

CONTINUUM OF CARE FOR ACUTE CORONARY SYNDROME:

OPTIMIZING TREATMENT FOR ST-ELEVATION MYOCARDIAL INFARCTION AND NON–ST-ELEVATION ACUTE CORONARY SYNDROME

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Dear Colleagues,

In this EMCREG-International Monograph, Continuum of Care for Acute Coronary Syndrome: Optimizing Treatment for STEMI and NSTE-ACS, you will find a detailed discussion regarding the treatment of this important disease entity, acute coronary syndrome (ACS), which impacts millions of patients across the United States each year. This is a "state-of-the-art" Monograph for emergency physicians, cardiologists, and hospitalists, which provides the evidence basis for the optimal approach to treating non–ST-elevation acute coronary syndrome (NSTE-ACS) and ST-elevation myocardial infarction (STEMI).

This Monograph is divided into 4 sections, which starts with the patient at home having symptoms of ACS interacting with the prehospital care system and finishing with the patient being discharged from the hospital to home with follow-up and treatment, which have a duration of more than 12 months. The first section carefully examines the prehospital evaluation and treatment of patients with symptoms consistent with ACS. The prehospital care system, using ambulances staffed by paramedics with Advanced Cardiac Life Support capabilities, is responsible for obtaining a 12-lead electrocardiogram, providing monitoring for cardiac dysrhythmias and initiation of treatment for ACS including aspirin and nitroglycerin. For patients with confirmed STEMI, P2Y12 platelet receptor antagonists such as ticagrelor can be administered in the ambulance. In the second section of this Monograph, the treatment of NSTE-ACS and STEMI is defined for patients with ACS entering the Emergency Department (ED) by private vehicle or ambulance. The importance of early identification of these patients with the 12-lead electrocardiogram and aggressive assessment by nurses suspecting serious disease promptly places patients on care pathways that include appropriate anticoagulation and treatment with dual antiplatelet therapy. For patients with STEMI presenting to the ED, the goal is to have the patient undergo percutaneous coronary intervention (PCI) in the cardiac catheterization laboratory with a resulting open coronary artery within 90 minutes from first medical contact in the prehospital environment or 60 minutes after presentation to the ED. The third section of this Monograph focuses on therapy in the cardiac catheterization laboratory and coronary care unit. The continuation of anticoagulation and antiplatelet therapy from the prehospital environment and the ED is supplemented by a detailed discussion of PCI and other therapies necessary to optimize the outcome for these often critically-ill patients. The final section of this Monograph discusses the discharge of patients from the hospital and the appropriate treatment and follow-up care pathways for these individuals. With publication in 2016 of the ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy in Patients with Coronary Artery Disease, the prolonged treatment of patients with ACS for 12 months after their initial presentation has become standard practice for these patients to decrease the potential for recurrence.

It is our sincere hope that you will find this EMCREG-International Monograph useful to you in your daily practice as an emergency physician, cardiologist, and hospitalist. This Monograph, reflecting dual input from experts in Emergency Medicine and Cardiology, is a state-of-the-art compilation of data on the treatment of NSTE-ACS and STEMI. The Emergency Medicine Cardiac Research and Education Group (EMCREG)-International was established in 1989 as an emergency medicine cardiovascular and neurovascular organization led by experts from the United States, Canada, and across the globe. We now have Steering Committee members from the United States, Canada, Australia, Belgium, Brazil, France, the Netherlands, New Zealand, Japan, Singapore, Sweden, and the United Kingdom. Now in our 29th year, we remain committed to providing you with the best educational programs and enduring material pieces possible. In addition to our usual Emergency Physician audience, we now reach out to our colleagues in cardiology, internal medicine, family medicine, hospital medicine, and emergency medicine with our EMCREG-International University of Cincinnati Office of CME accredited symposia and enduring materials. Instructions for obtaining CME from the University of Cincinnati College of Medicine, Office of Continuing Medical Education, are available at the conclusion of this February 2018 EMCREG-International Monograph.

Thank you very much for your interest in EMCREG-International educational initiatives, and we hope you visit our website (www.emcreg.org) for future educational events and publications. W. Brian Gibler, MD, President, EMCREG-International Professor of Emergency Medicine, University of Cincinnati College of Medicine.

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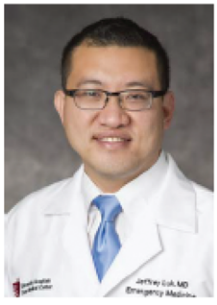

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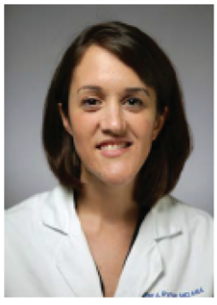

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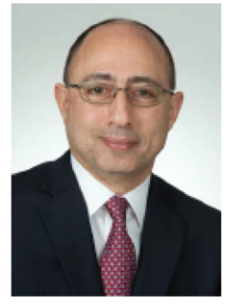

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Introduction: Approximately 250,000 patients suffer from an ST-elevation myocardial infarction (STEMI) each year in the United States.[1] In 2013, the American College of Cardiology Foundation and the American Heart Association updated guidelines for the management of STEMI.[2] A Class I recommendation for regional systems of STEMI care proposed "all communities should create and maintain a regional system of STEMI care that includes assessment and continuous quality improvement of emergency medical services and hospital-based activities."[2] To achieve this goal, prehospital agencies have multiple responsibilities that include performing a 12-lead electrocardiogram (ECG) at the site of first medical contact (FMC), transporting a STEMI patient directly to a primary percutaneous coronary intervention (PCI)–capable hospital for primary PCI and coordinating early activation of the cardiac catheterization laboratory (CCL). Together, these interventions facilitate an ideal FMC-to-device time goal of 90 minutes or less. Heterogeneity exists in organizational architecture and clinical practice protocols across systems. Such heterogeneity is complicated by variability in "(1) paramedic training, (2) availability of prehospital ECGs, (3) ability to transmit ECGs to receiving hospitals, (4) catheterization lab activation processes, (5) protocols for bypassing non–PCI-capable hospitals with direct transport to PCI-capable hospitals, (6) reperfusion strategy at non-PCI centers, (7) data registry participants, and (8) consistent process for feedback."[3] Accordingly, a single universal design is neither practical nor achievable given variations in prehospital and hospital resources, geography, population density, and transport distances.

To optimize clinical outcomes and overcome barriers that may hinder coordinated, efficient STEMI system care, regional leaders must unify to address such constraints and apply best practices. Competition in areas with multiple hospitals and physician groups can prevent a coordinated effort to achieve reperfusion in the most regionally efficient manner; this may force emergency medical system (EMS) providers to navigate complex referral networks. Development of a robust STEMI system of care requires investment in equipment and personnel for both prehospital agencies and hospitals. Prehospital agencies are challenged by escalating demand; this requires ongoing equipment maintenance and consistent education and training programs. Because EMS reimbursement is currently fixed regardless of the level of care, hospitals that agree to serve as PCI centers typically incur the burden of funding STEMI systems. In addition, although STEMI systems improve care processes, their effect on population-wide outcomes remains an active debate. Comprehensive data collection into a single warehouse is needed to assess community-wide outcomes and understand optimal system configurations. Participation in national registries and quality improvement programs is critical to continuous quality improvement. The aforementioned heterogeneity among EMS systems across the country requires that STEMI systems adapt to the local community with regard to referral patterns, interfacility transfers, and transport distances.[3]

Nevertheless, it has been shown that when a STEMI system of care is established in a region, both door-to-balloon (DTB) time and symptom onset-to-balloon time significantly decrease.[4] In the mid-1990s, University Hospitals Health System (UHHS) in Cleveland, Ohio, integrated the mechanism for prehospital agencies to perform and transmit prehospital ECGs. In 2005, the University Hospitals EMS Training and Disaster Preparedness Institute was established as a regional leader in prehospital medicine; around the same time, heparin and clopidogrel were incorporated into the EMS Institute's protocols for prehospital STEMI care. In 2015, clopidogrel was transitioned to ticagrelor for the prehospital setting to remain consistent with the latest guidelines and recommendations. Currently, UHHS consists of 15 hospitals, and the UH EMS Institute has over 150 prehospital agencies under its medical command in northeast Ohio. All the prehospital agencies adhere to system-wide prehospital protocols, which include that for STEMI care (Fig. 1).

Prehospital ECG Transmission: Prehospital ECG transmission is a critical component of any regional STEMI system. Patients with anterior wall STEMI who received emergent PCI have been retrospectively evaluated and categorized based on the mode of transport and prearrival STEMI notification.[5] Individuals who were transported by EMS with STEMI notification had the shortest DTB time and also had smaller infarct size compared with those who were transported without STEMI notification. The relationship between patient home distance from a PCI center, prehospital ECG use, and FMC-to-balloon time among STEMI patients using the ACTION-Get With the Guidelines Registry has been studied.[1] In this evaluation, prehospital ECGs were associated with a statistically significant 10-minute reduction in FMC-to-balloon time. Moreover, the association between prehospital ECGs and shorter FMC-to-balloon times was attenuated by 0.8 minute for every 10-mile increase in distance from a PCI center. The effect that wireless transmission of prehospital ECGs has on STEMI recognition and reperfusion times has also been evaluated.[6] Patients with prehospital ECGs had a mean transport time to the angioplasty suite of 43 minutes and a mean DTB time of 66 minutes compared with 49 minutes and 79 minutes, respectively, for those STEMI patients who did not receive prehospital ECGs. The patients in this study with prehospital STEMI identification and concomitant CCL activation had statistically significant reductions in mean transport time to the angioplasty suite and DTB time (33 and 58 minutes, respectively).

FMC-to-balloon times have been shown to decrease significantly with prehospital ECGs (140 vs. 106 minutes; $P = 0.01$) or prehospital CCL activations (125 vs. 98 minutes; $P = 0.04$).[7] Those individuals who received both prehospital ECGs and prehospital CCL activations had significantly reduced FMC-to-balloon times compared with those who did not (125 vs. 91 minutes; $P = 0.02$). The authors concluded that the "time-saving benefits of prehospital ECGs may not be fully realized unless prehospital CCL activations also occur."[7] When prehospital ECGs were combined with prehospital CCL activation, prehospital providers achieved further reductions in the median FMC-to-balloon time of approximately 24 minutes. In summary, prehospital ECGs facilitate prompt STEMI identification. The resultant temporal benefits optimize reperfusion strategies and may be complemented by prehospital CCL activation as discussed in the next section.

Prehospital CCL Activation: Prehospital CCL activation has been shown to reduce DTB time, but its effect on mortality for STEMI patients is uncertain. A retrospective cohort study to compare the effects of CCL activation before patient arrival versus activation after arrival in the Emergency Department (ED) has been performed.[8] Prehospital CCL activation was associated with a 14-minute shorter mean DTB time compared with ED CCL activation. In this analysis, 93% of prehospital CCL activations met the 90-minute target;

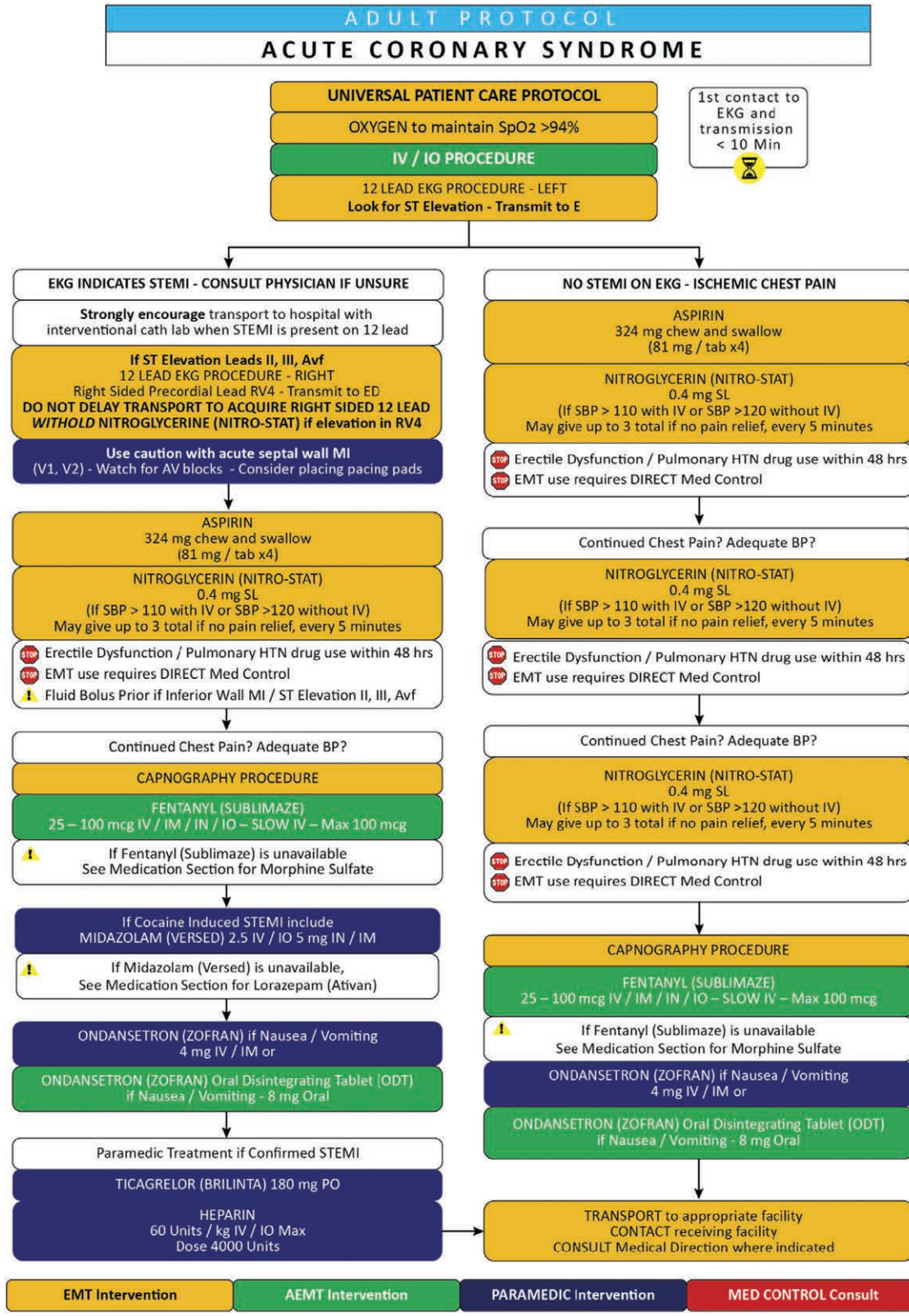

FIGURE 1. University Hospitals Emergency Medical Services Training and Disaster Preparedness Institute Prehospital Protocol for Acute Coronary Syndrome.

ED-based activations had 85% compliance. Patients with prehospital CCL activations in this study, however, had a 1.5% higher in-hospital mortality and a 7.8% higher false-positive activation rate than patients who had an ED-based CCL activation.

The DTB times and compliance with the national 90-minute DTB standard (at the time of the study) among 3 categories of STEMI patients has been studied: (1) EMS field activations, (2) patients transported by EMS without EMS CCL activation, and (3) walk-in STEMI patients.[9] The mean DTB time was shorter for the EMS field activations when compared with the other 2 categories. Compliance with the 90-minute benchmark was 100% for the EMS CCL activation group, 72% for prehospital transports without CCL activation, and 68% for walk-in STEMI patients.

Although prehospital CCL activation has been shown to provide process improvements, further refinements can be made. The clinical and ECG characteristics of STEMI patients who do not undergo PCI after prehospital CCL activation have also been evaluated.[10] Increased age, bundle branch block, elevated heart rate, left ventricular hypertrophy, and nonwhite race were all independently associated with an increased likelihood of not undergoing PCI. Out of these 5 variables, the 3 with the most significance were any type of bundle branch block [adjusted odds ratio (aOR) 5.66], left ventricular hypertrophy (aOR 4.63), and nonwhite race (aOR 3.53). The only variable associated with a higher likelihood of undergoing PCI was the presence of arm pain (aOR 2.94). These findings may lead to improvement of prehospital protocols by optimizing system-based clinical risk stratification protocols while minimizing false positive, or clinically inappropriate, prehospital CCL activations. False positive, or clinically inappropriate, CCL activation is a quality concern to any STEMI center. One study found a total positive and inappropriate CCL activation rate of 14%.[11] The authors of the study found that unwanted CCL activations were more likely to occur in men older than 65 years and patients with a history of coronary artery disease.

Overall, prehospital CCL activation improves DTB metrics. The reperfusion benefits of processes that improve patient progression to the CCL are well established.

Prehospital P2Y12 Receptor Antagonists: Pretreatment with P2Y12 receptor antagonists while en route to the CCL for emergent/urgent PCI in acute coronary syndromes (ACS) has potential advantages: lower incidence of intra- and postprocedural stent thrombosis, decreased periprocedural myocardial infarction, and less ancillary use of glycoprotein IIb/IIIa antagonists as a bail-out strategy. These potential advantages must be weighed against the potential disadvantages associated with potent antiplatelet agent pretreatment before invasive coronary angiography. These include (1) increased risk of bleeding events [both coronary artery bypass graft (CABG) and non–CABG-related bleeding], (2) higher risk of procedural bleeding (if access for coronary angiography is femoral), and (3) increased length of stay if patients require CABG (for the effects of potent antiplatelet agents to wear off).[12] Pretreatment with P2Y12 receptor antagonists can occur in the prehospital environment, the ED, the cardiac intensive care unit, or the CCL before PCI.[13] Clopidogrel, prasugrel, or ticagrelor are the most commonly used P2Y12 receptor antagonists.

Clopidogrel is an irreversible P2Y12 receptor antagonist. The onset of action is dose dependent (600 mg loading dose vs. 300 mg loading dose) and delayed with onset in 2–6 hours.[14] These kinetics render clopidogrel less effective if the pretreatment loading dose is administered after a diagnostic coronary angiogram immediately before PCI. There is paucity of high-fidelity, randomized controlled data to support the strategy of pretreatment of ACS patients with clopidogrel. The Clopidogrel for the Reduction of Events During Observation (CREDO) trial evaluated the use of a 300-mg loading dose of clopidogrel pretreatment versus placebo followed by a 75-mg maintenance dose for a duration of 12 months in the pretreatment group versus 1 month in the placebo group in 2116 patients with ACS.[15] The 18% relative risk reduction in the primary end point of death, myocardial infarction, or urgent target vessel revascularization at 28 days was not statistically significantly different between the pretreatment and no pretreatment groups. In the patients who received benefit from pretreatment, a prespecified subgroup analysis showed a 6-hour time lapse between the administration of clopidogrel and

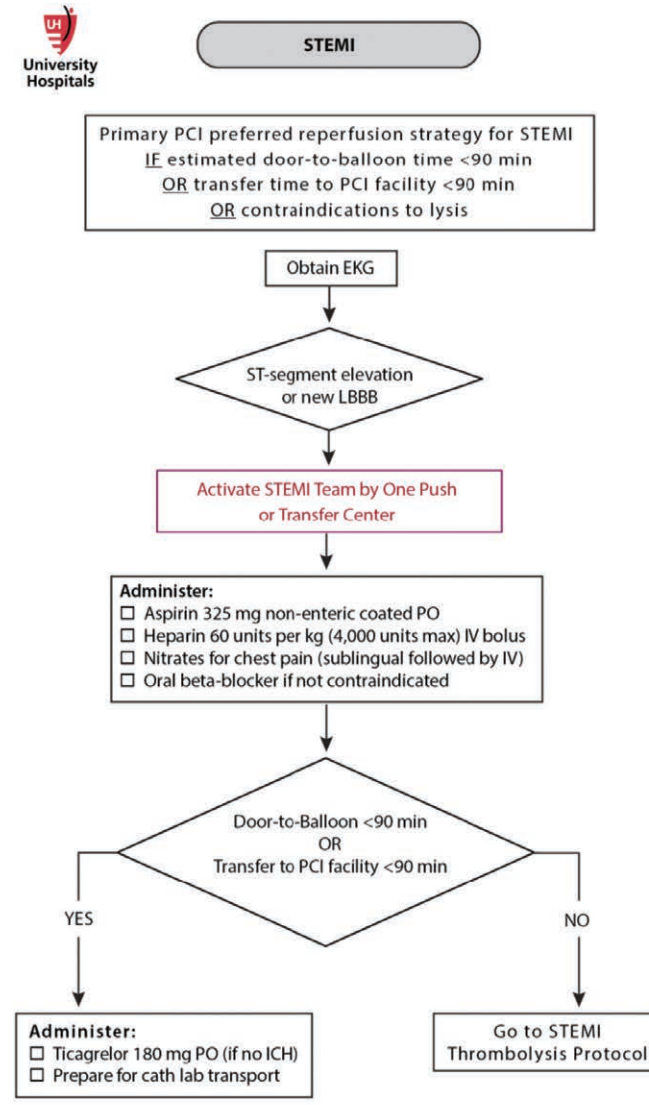

FIGURE 2. University Hospitals Health System ST-Elevation Myocardial Infarction (STEMI) Protocol.

performance of PCI. Also, a recent meta-analysis that included studies from the thrombolytic era showed no mortality benefit and a significantly higher bleeding risk with pretreatment using clopidogrel.[16]

Prasugrel is another oral, irreversible P2Y12 antagonist. Its onset of action is faster in comparison to clopidogrel (30 minutes–4 hours vs. 2–6 hours). The Comparison of Prasugrel at the Time of Percutaneous Coronary Intervention or as Pretreatment at the Time of Diagnosis in Patients with Non-ST Elevation Myocardial Infarction (ACCOAST) trial randomized biomarker-positive ACS patients with non–STEMI to pretreatment with 30-mg prasugrel before diagnostic angiography and an additional 30 mg at the time of PCI versus placebo before angiography followed by a 60-mg dose before PCI.[17] There were no between-group differences with regard to the composite end point of cardiovascular death, myocardial infarction, stroke, urgent revascularization, or unplanned use of glycoprotein IIb/IIIa inhibitors through 7 days. However, patients in the pretreatment group had significantly higher

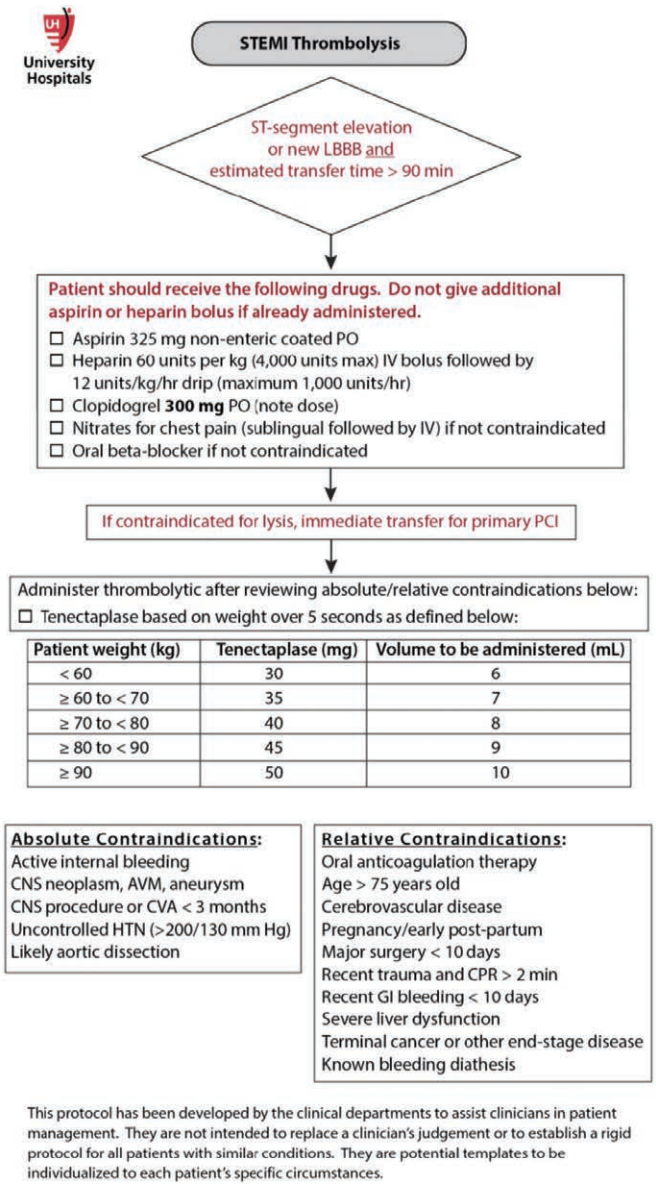

FIGURE 3. University Hospitals Health System ST-Elevation Myocardial Infarction (STEMI) Thrombolysis Protocol.

major bleeding events (2.6% vs. 1.4%; hazard ratio, 1.90; 95% confidence interval, 1.19–3.02 for Thrombolysis in Myocardial Infarction [TIMI] major bleeding) that led to premature termination of the trial by the Data Safety Monitoring Board.

Ticagrelor is a reversible oral P2Y12 antagonist that, unlike clopidogrel and prasugrel, does not require in vivo conversion to an active metabolite. Therefore, it has a significantly faster onset of action (30 minutes–2 hours). Ticagrelor was approved for use in ACS patients (both NSTEMI and STEMI) following data from the PLATelet inhibition and patient Outcomes (PLATO) trial that randomized 18,624 patients to upstream administration of either ticagrelor or clopidogrel (300–600 mg loading dose) before any procedure in the CCL.[18] In patients who received ticagrelor, there was a significant reduction in the combined primary end point of death from any vascular cause, myocardial infarction, or stroke (9.8% vs. 11.7%; hazard ratio, 0.84; 95% confidence interval, 0.77–0.92), but there was not an increased incidence of major bleeding. Ticagrelor use was, however, associated with an increase in non–CABG-related bleeding events. Administration of upstream ticagrelor is a Class I indication in the current guidelines in patients at high risk of ischemic events.[19] The Administration of Ticagrelor in the Cath Lab or in the Ambulance for New ST-Elevation Myocardial Infarction to Open the Coronary Artery (ATLANTIC) trial specifically addressed the question of pretreatment with ticagrelor in the prehospital environment or the ED versus its administration in the CCL. Because only 1862 patients were enrolled, the trial was not powered to determine superiority of pretreatment with regard to clinical end points. Surrogates were used to assess between-group differences: electrocardiographic resolution of ST-elevation greater than 70% before PCI and angiographic lack of TIMI III flow, respectively. There were no significant between-group differences in the co-primary surrogates of ST-segment resolution or TIMI III flow.[20]

A System-Based Approach: Effective regional STEMI care demands: (1) a sophisticated partnership between prehospital agencies, hospitals within the system, and providers across multiple disciplines; (2) continuous review of every echelon's adherence to established guidelines through a robust, multidisciplinary quality assurance process; (3) frequent re-examination of the evidence to update guidelines accordingly; (4) a strategy to ensure continuing education; and (5) feedback for their prehospital providers. As systems seek to streamline patient movement from the field to the CCL, their leadership must develop detailed guidelines for prehospital CCL activation to minimize clinical overtriage. In the UHHS, the integration of the UH Center for Patient Flow Management (CPFM) provides 24/7 navigation support to ensure the right patient is transported to the right facility. The CPFM connects all providers in the patient's care continuum to mitigate overtriage through visualization of the prehospital ECG and communication between all providers. As the "eyes in the sky," the CPFM oversees patient movement throughout the system of 15 hospitals and optimizes the deployment of personnel resources and hospital capabilities to meet the needs of each patient. Coupled with coordinated oversight of a simplified "no-drips" STEMI protocol by prehospital agencies, UHHS patients have distributed access to PCI at community hospitals with continuous high quality as close to their home as possible (Fig. 2).

The UHHS STEMI protocol is one example of an integrated, multidisciplinary approach. It optimizes standardized prehospital clinical care as outlined in Figs. 1 and 2. Notably, given the broad geographic base, some clinical situations preclude a 90-minute FMC-to-device time. The UHHS STEMI protocol, therefore, also includes a simplified thrombolysis transport protocol (Fig. 3).

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APPROPRIATE EVALUATION AND TREATMENT OF ST-ELEVATION MYOCARDIAL INFARCTION AND NON–ST-ELEVATION ACUTE CORONARY SYNDROME

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Introduction: ST-elevation myocardial infarction (STEMI) and non–ST-elevation acute coronary syndrome (NSTE-ACS) can cause significant morbidity and mortality if not treated aggressively and appropriately. Delay in the appropriate treatment of either entity can result in adverse outcomes for patients who present to the Emergency Department (ED) for care. The 2013 American College of Cardiology Foundation/American Heart Association (ACCF/AHA) Guidelines for Management of STEMI[1] and the 2014 American Heart Association/American College of Cardiology (AHA/ACC) Guidelines for the Management of Patients with NSTE-ACS[2] outline the recommended acute care therapies for these 2 patient populations. This article focuses on the early triage and treatment of STEMI and NSTE-ACS, especially as it relates to dual antiplatelet therapy in the ED and cardiac catheterization laboratory. The most recent 2016 ACC/AHA Guidelines for the Duration of Dual Antiplatelet Therapy[3] clarifies the recommendations on the long-term therapy for STEMI and NSTE-ACS patients. The 3 guidelines were promulgated to standardize and optimize the evaluation, diagnosis, and management of patients with STEMI and NSTE-ACS and to provide physicians with a framework for clinical decision making. They have become the cornerstone of many ED protocols for the treatment of STEMI and NSTE-ACS and are crucial to providing efficient care in the ED and seamless transitions for patients to the cardiac catheterization laboratory or coronary care unit. In addition, the guidelines and new clinical trials data support changes in the dosing and application of antiplatelet therapy in the treatment of STEMI and NSTE-ACS.

STEMI Versus NSTE-ACS: Initial Triage And Risk Stratification: The pathophysiology of acute coronary syndrome (ACS) is initiated by the endothelial rupture of an atherosclerotic coronary artery plaque. Plaque rupture leads to platelet aggregation, platelet activation, fibrin deposition, and downstream myocardial ischemia and necrosis. Especially in STEMI, downstream necrosis is time dependent, with tissue ischemia and localized infarction progressing to a wave front of necrosis developing from the subendocardium and extending transmurally outward with time. The longer the period of necrosis, the higher the chance of heart failure, patient morbidity, and death. As such, rapid diagnosis and treatment are important in patients with STEMI.

In patients with chest pain and presumed coronary syndromes, the first step in triage is obtaining a 12-lead electrocardiogram (ECG) within 10 minutes after medical provider contact. This test can be performed in the field by trained emergency medical technicians or paramedics, in the ED triage area by hospital staff, or at the bedside in the ED by nursing. The initial choice of treatment pathways between STEMI and NSTEMI is based on the presence of ST-elevation or a new left bundle branch block on the 12-lead ECG. If these are present, the patient follows the STEMI pathway. If these findings are not present, the patient initially follows the NSTE-ACS pathway (Fig. 1). It is worth noting that the ECG is only a snapshot in time and that often serial ECGs are needed to detect evolving STEMI or evolving ST depression in patients with ACS. In patients with clinical instability, fluctuating or severe pain, or a high index of clinical suspicion, serial ECGs are indicated.[2]

Treatment Of STEMI: Time is of the essence in the care of patients with STEMI. Care occurs across the continuum, from the patient's bedside at home, to emergency medical systems (EMS) transport to the ED and finally to the cardiac catheterization laboratory. The care of a patient with STEMI is influenced by patient education (recognition of symptoms), EMS dispatch (availability of 911 capability), EMS access and capability (availability of field ECG and rapid response/ transport), EMS communication (ED or cardiac catheterization laboratory activation), ED nursing (throughput and patient stabilization), emergency physician care (stabilization, activation of the cardiac catheterization laboratory, and appropriate therapy), cardiac catheterization laboratory staff (patient preparation and equipment), and interventional cardiology [rapid and skilled percutaneous coronary intervention (PCI); Fig. 2].[1] Coordination across all of these groups to achieve a first medical contact (FMC) to balloon time of 90 minutes or less can be a formidable task. The ACCF/AHA Guidelines for the treatment of STEMI recommend that "all communities should create and maintain a regional system of STEMI care" that includes assessment and continuous quality improvement of EMS and hospital-based activities.[1]

Reperfusion is the cornerstone of appropriate therapy in STEMI. Emergency physicians who work in PCI-capable hospitals should choose PCI as their reperfusion methodology of choice. Physicians at rural hospitals, where patient transfer to a PCI-capable hospital is prolonged, should choose timely fibrinolytic therapy as their reperfusion method of choice. There is a distinct gray zone, however, in patients for whom the choice must be made between timely fibrinolysis versus patient transfer for "minimally or moderately delayed" primary PCI. The emergency physician must decide between fibrinolysis within 30 minutes of FMC versus transfer for PCI, knowing that the chance of a FMC-to-balloon time in the setting of an interhospital transfer within 90 minutes is remote.

The choice of PCI versus fibrinolytic therapy will determine the appropriate antithrombin and antiplatelet regimens in STEMI. All STEMI patients should receive aspirin 325 mg at initial patient contact, preferably in the prehospital arena and perhaps even before an ECG is done (IA recommendation).[1] In addition, once the reperfusion pathway is chosen, patients should receive a second antiplatelet agent (dual antiplatelet therapy) and an antithrombin in the ED or in the cardiac catheterization laboratory (IB recommendation).[1] The choices for antiplatelet and antithrombin therapy are also dependent on the reperfusion methodology and are illustrated in Figure 3. Whereas aspirin should be administered immediately, the addition of an antithrombin and a second antiplatelet can occur in the ED or in the catheterization laboratory at the time of reperfusion. If there is any delay to reperfusion therapy, however, they should be administered as soon as possible in the ED.

Treatment of NSTE-ACS: The 2014 AHA/ACC Guidelines recommend the early application of risk stratification for all patients with chest pain or other anginal equivalents and presumed NSTE-ACS.[2] The results of risk stratification should be used to determine downstream management strategies. Higher risk patients are recommended to pursue an invasive pathway (Fig. 4) with upstream antiplatelet and antithrombin therapy administered before planned cardiac catheterization. Patients at high risk include those with clinical instability (heart failure, hypotension, and ongoing chest pain), rhythm instability, ST-depression or transient ST-elevation, an elevated troponin level, an elevated Thombolysis in Myocardial Infarction (TIMI) risk score, or a history of coronary artery disease or coronary intervention. These patients should be

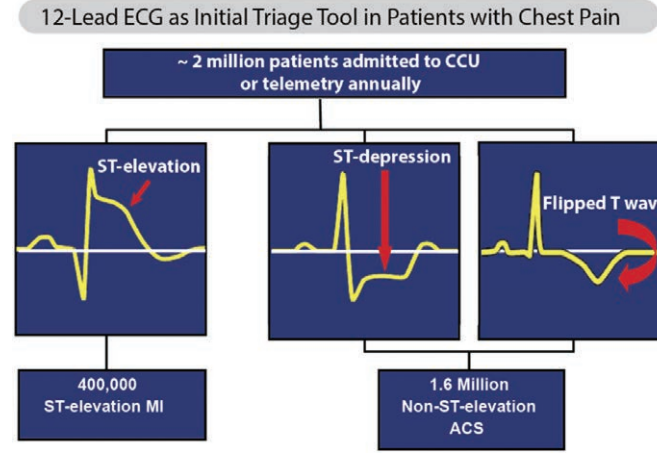

FIGURE 1. Initial ECG as a triage tool in patients with chest pain.

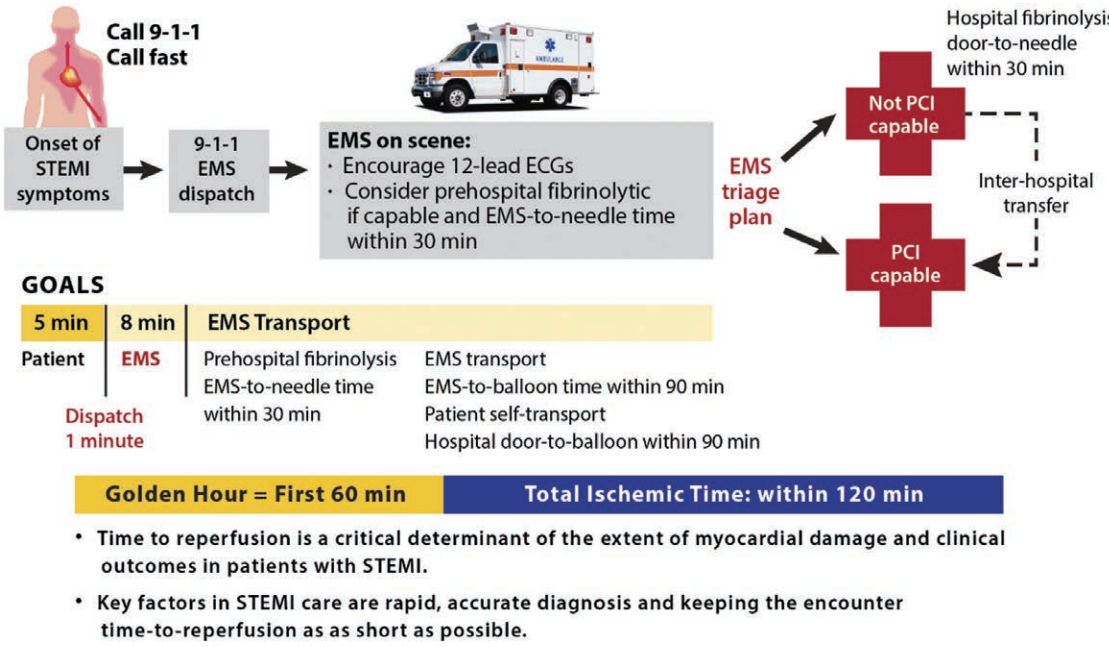

FIGURE 2. Time to treatment is critical in STEMI.

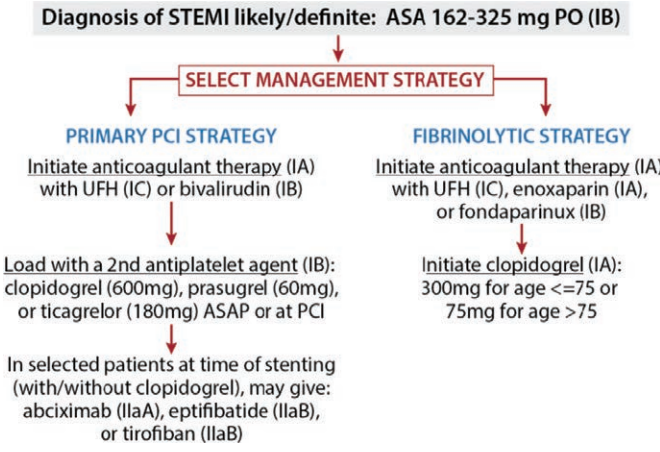

FIGURE 3. ACCF/AHA 2013 ST-segment elevation myocardial infarction guidelines for initial antiplatelet therapy by reperfusion strategy.

placed in an invasive therapy treatment regimen with planned cardiac catheterization within 24 hours.[2]

Lower risk patients, or patients who have a contraindication to cardiac catheterization, are suggested to pursue a conservative therapy with a less aggressive set of antithrombin and antiplatelet recommendations.[2] With either invasive or conservative pathways, dual antiplatelet therapy is indicated (IB recommendation; Fig. 4).[2]

Dual Antiplatelet Therapy in STEMI And NSTEMI: The 2013 ACC/AHA Guidelines for STEMI and the 2014 Guidelines for NSTE-ACS incorporate recent clinical trials data and include updated recommendations on antiplatelet treatment strategies for STEMI and NSTE-ACS treated with PCI. Oral dual antiplatelet therapy starts with aspirin, which is recommended upstream for both STEMI and NSTE-ACS.[1,2] The second antiplatelet for STEMI or NSTE-ACS is a P2Y12 inhibitor, which can be initiated in the ED or in the cardiac catheterization laboratory.[1,2] Options include clopidogrel 600 mg, prasugrel 60 mg, or ticagrelor 180 mg, given orally as a loading dose (IB recommendation) for STEMI or NSTE-ACS. These oral agents are more potent antiplatelet therapy than aspirin, and each has been shown to be effective in STEMI and NSTE-ACS. It should be noted that the 3 agents are not interchangeable, however. Clopidogrel has been shown to cause variable platelet response, especially in patients with certain genetic or medication-induced reductions in hepatic metabolism of clopidogrel. Both prasugrel and ticagrelor have been shown to be more potent antiplatelet agents than clopidogrel. They both have a more rapid onset and more consistent antiplatelet activity than clopidogrel. Both have been investigated in STEMI and NSTE-ACS patients treated by an invasive pathway, and both provide significant reductions in ischemic end points compared with clopidogrel.[4–6]

Ticagrelor was evaluated in the PLATelet inhibition and patient Outcomes (PLATO) trial, which enrolled 18,624 patients with either STEMI or NSTE-ACS destined for the cardiac catheterization laboratory.[5] Patients in PLATO were enrolled and randomized upstream, before their coronary angiograms. Approximately 70% of the patients in PLATO underwent PCI, and the rest were treated with coronary artery bypass grafting (CABG), medical therapy, or no therapy. The primary outcome for the trial was death from vascular causes, myocardial infarction (MI), and stroke at 1 year. Ticagrelor treatment resulted in a 16% reduction in this triple end point of death from vascular causes, MI, and stroke in ACS patients at 1 year—11.7% in the clopidogrel-treated patients versus 9.8% in the ticagrelor-treated patients (hazard ratio 0.84; 95% confidence interval [CI], 0.77–0.92; $P < 0.001$).[5] In addition, cardiac mortality was reduced in the ticagrelor group at 1 year from 5.1% to 4.0% (hazard ratio: 0.79; 95% CI, 0.69–0.91). Total major bleeding, transfusions, and life-threatening bleeding were not significantly different between groups, but when non-CABG bleeding alone was analyzed, there was a significant increase in non-CABG bleeding with ticagrelor (4.5% vs. 3.8%; $P = 0.03$). This was offset by a nonsignificant decrease in CABG bleeding with ticagrelor (7.4% vs. 7.9%; P = not significant). Despite theoretical advantages of a short half-life antiplatelet agent in patients proceeding to CABG after angiogram, there were no significant reductions in bleeding in the CABG cohort in PLATO.[7] Ticagrelor has received a IB recommendation for NSTE-ACS, whether treated with invasive or conservative pathways.[2] The PLATO trial also enrolled 7026 patients with STEMI, randomized to

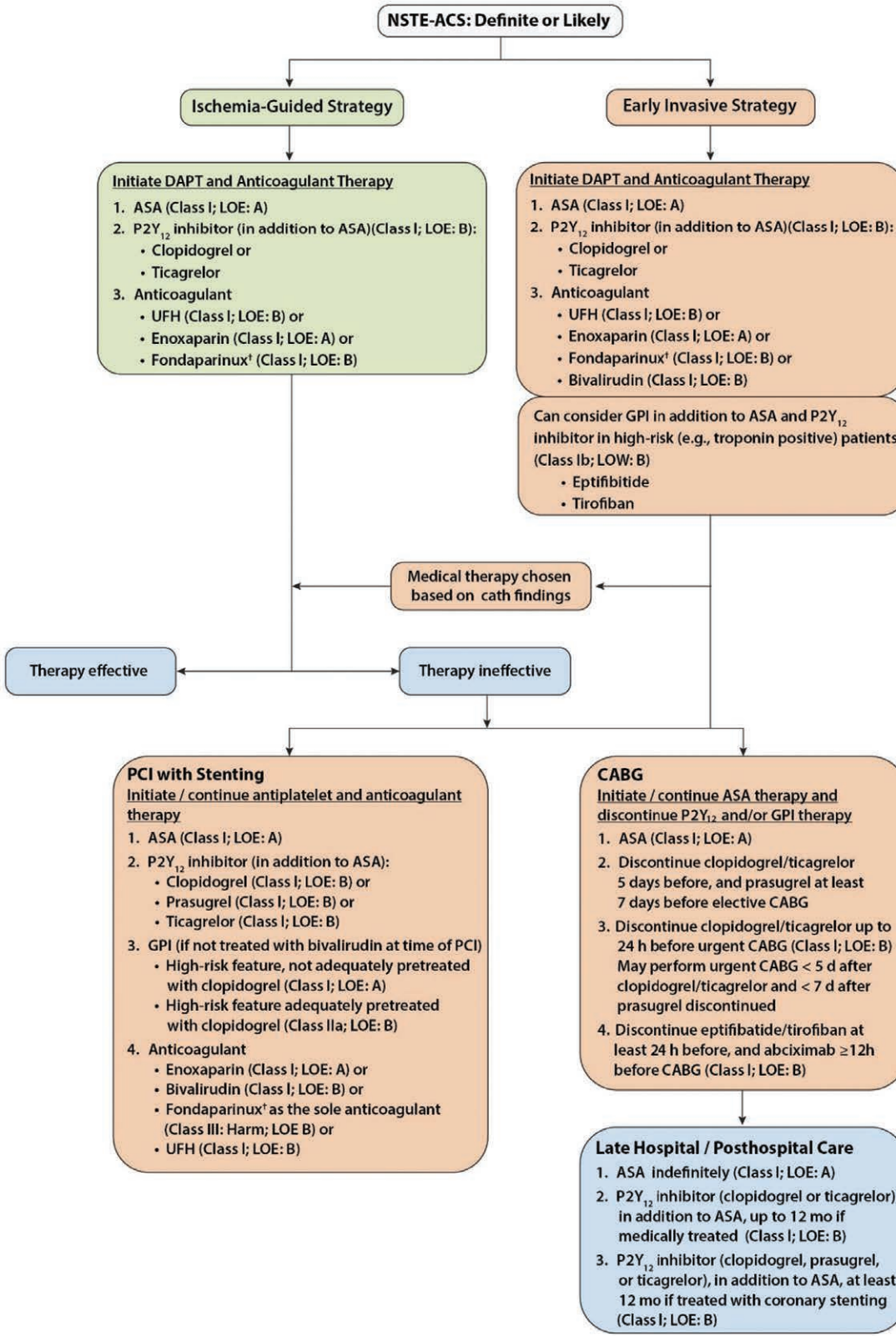

FIGURE 4. ACCF/AHA 2014 NSTE-ACS antiplatelet therapy by treatment strategy.

ticagrelor versus clopidogrel.[8] In these STEMI patients, ticagrelor resulted in a 16% relative risk reduction in death from vascular causes, MI, and stroke at 1 year compared with clopidogrel—10.1% in the clopidogrel-treated patients versus 8.5% in the ticagrelor-treated patients (hazard ratio: 0.84; 95% CI, 0.72–0.98). Bleeding rates in the STEMI patients were similar between ticagrelor and clopidogrel, making ticagrelor a preferred option in ED treatment of STEMI before primary PCI (IB recommendation).[1]

Prasugrel was evaluated in the TIMI 38 trial, in which 13,608 patients with either STEMI or moderate- to high-risk NSTE-ACS and planned intervention for a known intracoronary lesion were randomized in a double blind fashion to receive either a 300 mg load of clopidogrel and 75 mg per day or a 60-mg load of prasugrel and 10 mg a day, beginning at the time of catheterization and continuing for 1 year.[6] It should be noted that this randomization occurred after the initial coronary angiogram. Prasugrel was not evaluated upstream in NSTE-ACS but only in the cardiac catheterization laboratory after the coronary anatomy was defined. At 1 year, prasugrel was associated with a 19% reduction in death, MI, and stroke (hazard ratio: 0.81; 95% CI, 0.73–0.90) compared with clopidogrel. Bleeding was increased in the prasugrel group, however, with an overall 0.6% increase in major bleeding (2.4% vs. 1.8%; hazard ratio 1.32; 95% CI, 1.03–1.68). Fatal bleeding, transfusions, and CABG bleeding were all significantly higher in the prasugrel group, and bleeding was especially higher in the elderly (>75 years old), in patients with low body weight (weight <60 kg), and in patients with prior transient ischemic attack or cerebrovascular accident. There was a definite trade-off noted between increased efficacy and increased bleeding, prompting the authors of the study to caution against the use of prasugrel in these high-risk groups. The lack of any precatheterization medical management in the TIMI 38 trial, and the high rate of CABG-related bleeding, makes this drug less applicable in the ED setting for patients with NSTE-ACS.[2]

The TRial to Assess Improvement in Therapeutic Outcomes by Optimizing Platelet InhibitioN with Prasugrel (TRITON-TIMI 38) trial also enrolled 3534 patients with STEMI treated with either primary or secondary PCI.[9] In these patients, prasugrel 60 mg resulted in a 19% relative risk reduction in death, MI, and stroke at 15 months (hazard ratio 0.81; 95% CI, 0.66–0.99) compared with clopidogrel 300 mg. Bleeding still trended worse in the prasugrel arm, but there were no statistically significant differences in bleeding, including life-threatening bleeding. Unlike the NSTE-ACS population in TRITON, the STEMI patients were often randomized to prasugrel

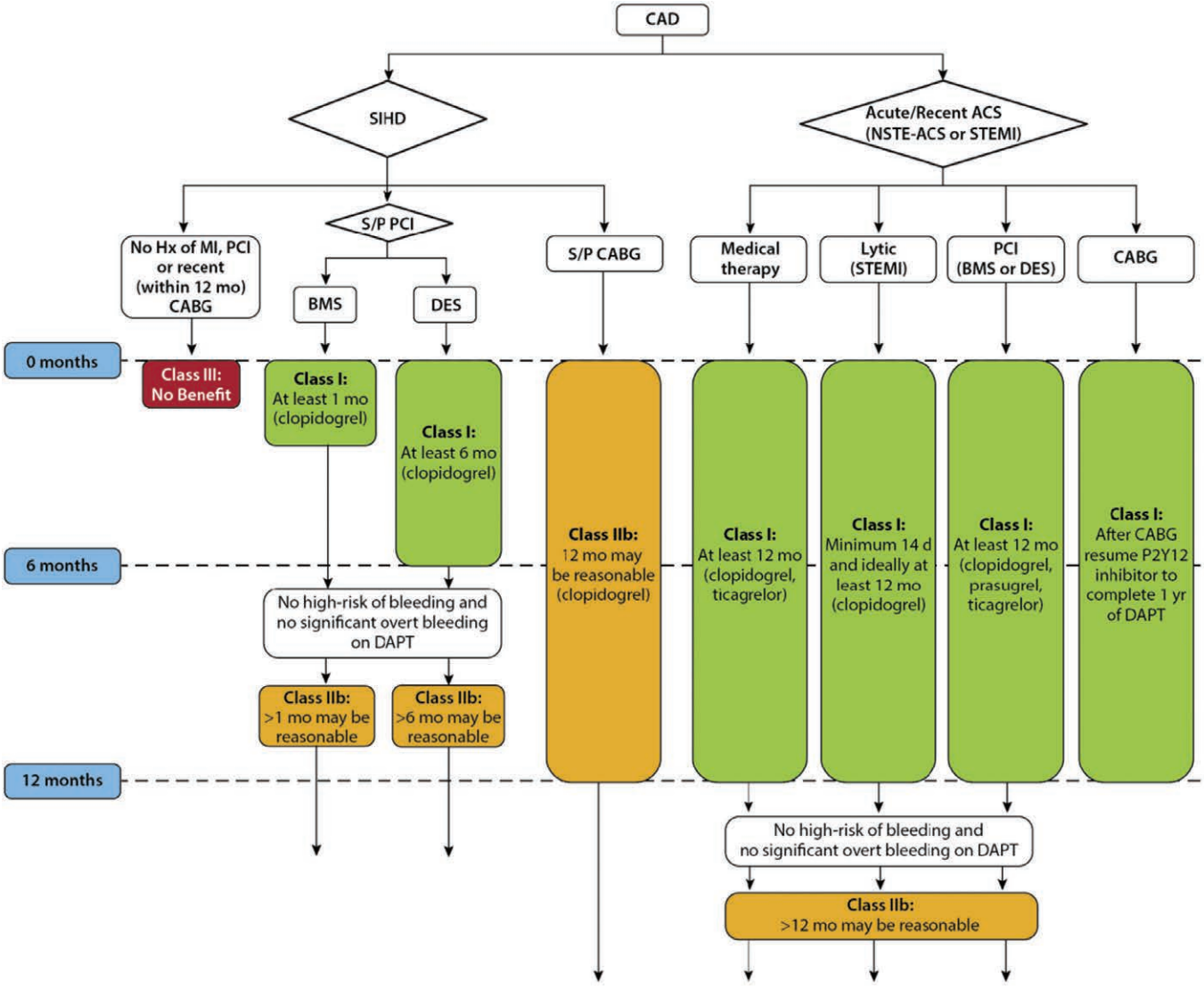

FIGURE 5. Master treatment algorithm for duration of P2Y12 inhibitor therapy in patients with CAD treated with dual antiplatelet therapy. BMS, ; DES, ; SIHD, .

upstream, before angiography. As such, these results support the use of prasugrel in the ED in STEMI patients.

The guidelines recommend the use of prasugrel 60 mg orally as a loading dose at the time of primary PCI for STEMI (IB recommendation).[1] They also give prasugrel a IB recommendation as a loading dose at the time of PCI for NSTE-ACS, except in patients already on clopidogrel.[2] The guidelines also include a Class III recommendation (harmful) for the use of prasugrel in patients older than 75 years, with weight <60 kg, or with a history of transient ischemic attack/stroke.[2] Emergency physicians should be aware of prasugrel's mechanism of action, pharmacology, and clinical application in the treatment of these patients.

As an alternative to P2Y12 inhibitors for platelets, intravenous glycoprotein IIb/IIIa inhibitors can be utilized in the cardiac catheterization laboratory at the discretion of the cardiologist. The glycoprotein IIb/IIIa inhibitors provide instant-onset high-potency antiplatelet inhibition for patients with high-risk lesions in STEMI and NSTE-ACS. They are not presently recommended upstream in either STEMI or NSTE-ACS due to associated bleeding risk (IIbB recommendation).[2] They are effective, however, if initiated in the cardiac catheterization laboratory for both STEMI and NSTE-ACS (IA recommendation).[1,2] In addition, the GP IIb/IIIa platelet receptor antagonists should be followed long term with oral antiplatelet therapy, typically with a P2Y12 inhibitor.

Duration of Oral Dual Antiplatelet Therapy: The 2016 ACC/AHA Guideline Focused Update on Duration of Dual Antiplatelet Therapy provides significantly more detail on duration of antiplatelet therapy in an area that has been very controversial (Fig. 5).[3] Specifically, it includes the results of the Dual Antiplatelet Therapy Study,[10] which was specifically designed to answer questions about duration of dual antiplatelet therapy, especially in patients who receive drug-eluting stents. After NSTE-ACS or STEMI, treated either medically or with PCI, the guidelines recommend aspirin 81 mg per day indefinitely (1A recommendation). Dual antiplatelet therapy with aspirin and a P2Y12 inhibitor is given a Class I recommendation (should be given) for a minimum of 6–12 months and a Class IIb recommendation (should be considered) for prolonged therapy thereafter.[3] In patients with high ischemic risk and lower bleeding risk, dual antiplatelet therapy can be considered for a longer duration. In those with higher bleeding risk, it is probably not as beneficial. The Dual Antiplatelet Therapy (DAPT) study introduced the DAPT score to estimate bleeding risk. Patients with a DAPT score >2 will likely benefit from prolonged therapy, whereas those with a DAPT score <2 should receive a more limited therapy duration.[10]

CONCLUSIONS: STEMI and NSTE-ACS remain high prevalence, high impact diagnoses in the prehospital arena and in the ED. Emergency physicians should treat these patients aggressively with timely therapy to reduce mortality and morbidity. It is imperative for ED physicians to be knowledgeable about the recommended therapies for these conditions in the ED, including the appropriate and aggressive application of dual antiplatelet therapy.

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OPTIMAL CARE FOR PATIENTS WITH ST-ELEVATION MYOCARDIAL INFARCTION AND NON–ST-ELEVATION ACUTE CORONARY SYNDROME IN THE CARDIAC CATHETERIZATION LABORATORY AND CORONARY CARE UNIT

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Introduction: Optimal care for patients with acute coronary syndrome (ACS), including both ST-elevation myocardial infarction (STEMI) and non–ST-elevation myocardial infarction (NSTEMI), in the cardiac catheterization laboratory and the coronary care unit has rapidly progressed over the past decade with improvements in earlier recognition of ACS, reperfusion therapy, antiplatelet agents, stent technology, transradial access, and post-ACS care coordination. Hospital mortality rates for patients with STEMI range between 2.5% and 10%, depending on treatment strategies. For those patients treated with percutaneous coronary intervention (PCI), the mortality rates are between 3% and 8% for STEMI and 2% and 4% for NSTEMI presentations. Declines in mortality after myocardial infarction over the past several decades have been significant among both men and women and among all racial subgroups.[1] Despite these improvements, the number of short-term readmissions after myocardial infarction remain high.[2] In 2013, there were over 71,000 readmissions to US hospitals within 30 days of discharge, at an aggregate cost of over 1 billion US dollars. In this review, the optimal care for patients with ACS in the cardiac catheterization laboratory and the coronary care unit will be examined and defined. Practices that are supported by the guidelines and literature for the care of ACS patients in both settings and are aimed at continuing to improve post-ACS outcomes and reduce complications will be described.

Optimal Care for the Patient With STEMI in the Cardiac Catheterization Laboratory

Antithrombotic Therapy

Optimal care for patients presenting with STEMI includes careful consideration of antithrombotic therapy before and during PCI, starting with loading the patient with aspirin and a P2Y12 inhibitor, such as clopidogrel, prasugrel, or ticagrelor, before arrival in the catheterization laboratory (often in the Emergency Department) or upon arrival to the catheterization laboratory. Higher potency P2Y12 inhibitors, such as ticagrelor and prasugrel, are favored over clopidogrel in eligible patients. The TRial to Assess Improvement in Therapeutic Outcomes by Optimizing Platelet InhibitioN with Prasugrel (TRITON-TIMI 38) trial demonstrated reduced 30-day death from cardiovascular causes, nonfatal myocardial infarction, or nonfatal stroke with the use of prasugrel over clopidogrel.[3] However, it is important to note that some patients should not be considered for prasugrel therapy. Specifically, patients with a history of stroke or transient ischemic attack, patients older than 75 years, and patients <60 kg should not be loaded with prasugrel. In the PLATelet inhibition and patient Outcomes (PLATO) trial, use of ticagrelor resulted in improved outcomes in the primary PCI group with regard to death and stent thrombosis compared with clopidogrel.[4] Patients with a history of intracranial bleeding, however, should not be loaded with ticagrelor, and ticagrelor should be used cautiously in patients with second- or third-degree heart block, as well as sick sinus syndrome. For patients who have received clopidogrel before arriving in the catheterization laboratory or cardiac intensive care unit, it is reasonable to switch to ticagrelor, simply by using the initial loading dose (180 mg) followed by 90 mg twice a day.

Although it is estimated that roughly 25%–30% of the population may carry the CYP2C19*2 allele that results in lower levels of the active metabolite of clopidogrel, there has been controversy in the literature regarding whether this allele is associated with adverse outcomes, including early stent thrombosis.[5–7] Additional subgroups may have varied responses to clopidogrel, including patients with the ABCB 1 polymorphism, diabetics, and obese patients. It is not currently recommended that patients presenting with STEMI routinely undergo the VerifyNow-P2Y12 testing for appropriate platelet inhibition with clopidogrel, but this testing may be considered if patients present with stent thrombosis after appropriate clopidogrel compliance.

Access Considerations: Reduced mortality rates, likely because of reductions in bleeding, have been observed with the use of transradial access for patients presenting with STEMI. In the Radial Versus Femoral Randomized Investigation in ST-Elevation Acute Coronary Syndrome (RIFLE-STEACS) trial, which investigated outcomes in the STEMI population, the composite outcomes of net adverse clinical events, and cardiovascular mortality were significantly reduced in the transradial versus the transfemoral arm.[8] Additionally, in an analysis of the RadIal Vs femorAL access for coronary intervention (RIVAL) trial comparing outcomes of transradial versus transfemoral access between NSTEMI and STEMI patients, the primary composite outcome of death, myocardial infarction (MI), stroke, and noncoronary artery bypass grafting (CABG)–related major bleeding was significantly reduced in the STEMI subgroup but not the NSTEMI subgroup.[9] In the Minimizing Adverse Haemorrhagic Events by TRansradial Access Site and Systemic Implementation of angioX (MATRIX Access) trial, there was a borderline significant reduction in all-cause mortality with the use of transradial access, regardless of ACS type.[10] For the population of patients presenting with STEMI, transradial access is now recommended as a Class I level of evidence A recommendation in the European Society of Cardiology (ESC) guidelines[11] if performed by an experienced radial operator. Table 1 illustrates the major randomized trials supporting the use of transradial access in ACS overall, STEMI, and NSTEMI.

Culprit Artery–Only Versus Multivessel PCI: The 2013 American College of Cardiology Foundation/American Heart Association (ACCF/AHA) Guideline for the Management of STEMI[12] gave PCI of a noninfarct artery at the time of primary PCI in a hemodynamically stable patient presenting with STEMI a class III recommendation. This recommendation was based on observational studies and meta-analyses suggesting that patients with multivessel PCI at the time of primary PCI trended toward worse outcomes and were exposed to longer procedural times with greater risk of contrast nephropathy and stent thromboses.[13,14] However, with new data from several randomized control trials (RCTs), the 2015 ACC/AHA/Society for Cardiac Angiography and Interventions (SCAI) Focused Update on Primary PCI for Patients with STEMI[15] updated the recommendation for multivessel PCI at the time of primary PCI or as a staged procedure to a Class IIb recommendation, and the 2017 ESC guidelines give a IIa recommendation for nonculprit stenting before hospital discharge.

The change in recommendation for multivessel PCI in the recent guidelines is based on several RCTs, including the Complete Versus Culprit-Lesion Only Primary PCI (CvLPRIT) and Preventive Angioplasty in Acute Myocardial Infarction (PRAMI) trials.[16,17] In the CvLPRIT trial, 296 patients with STEMI were randomized to infarct artery and noninfarct artery PCI within the index hospitalization versus infarct artery-only PCI. The primary end point, a composite of all-cause death, recurrent MI, heart failure, and ischemia-driven revascularization within 12 months, occurred in 10% of the complete revascularization group versus 21.2% of the infarct-only revascularization group ($P = 0.009$). In the PRAMI trial, the composite end point of cardiac death, nonfatal MI, or refractory angina occurred in 9% of STEMI patients undergoing multivessel primary PCI versus 22% with infarct artery–only PCI ($P < 0.001$). Although not all hemodynamically stable patients presenting with STEMI and multivessel disease should undergo multivessel or staged PCI within the index hospitalization, it is now appropriate to consider it. Table 2 provides recommendations for PCI based on the 2015 ACC/AHA STEMI Guidelines.

Cardiogenic Shock: The most important opportunity to improve the care of patients with acute MI complicated by cardiogenic shock is early

TABLE 1. Summary of Major Trials of Radial Access in ACS

Study (Year)	Number of Patients	Primary Endpoints	Results
RIVAL (2011)	3,507	30-day composite of death, MI, stroke, or non-CABG-related major bleeding	No difference in primary endpoint between radial and femoral access
MATRIX (2015)	8,404	30-day MACE and NACE	30-day MACE (8.8% vs. 10.3%, p=0.0307) and NACE (9.8% vs. 11.7%, p=0.0092) reduced with radial access
SAFE-PCI (2014)[28]	1,787	Primary efficacy endpoint: BARC type 2, 3, or 5 bleeding or vascular complications requiring intervention; primary feasibility endpoint: access site crossover	Trial terminated early due to lower than expected event rate; no significant difference in primary efficacy endpoint; femoral access associated with lower access site crossover (p<0.01)
RADIAL-AMI (2005)[29]	50	Reperfusion time, major bleeding, access site complications	Femoral access associated with shorter reperfusion time; no difference in access site complications or major bleeding
RIFLE-STEACS (2012)	1,001	30-day rate of NACE, defined as a composite of cardiac death, stroke, myocardial infarction, target lesion revascularization, and bleeding	30-day NACE (13.6% vs. 21.0%, p=0.003), radial vs. femoral arms
STEMI-RADIAL (2014)[30]	707	30-day major bleeding and vascular access complications	30-day major bleeding and vascular access complications: 1.4% vs. 7.2% (p=0.0001), radial vs. femoral arms

MACE, major adverse cardiovascular events; NACE, net adverse clinical events; RADIAL-AMI, radial versus femoral access for emergent percutaneous coronary intervention with adjunct glycoprotein IIb/IIIa inhibition in acute myocardial infarction; SAFE-PCI, Study of Access Site for Enhancement of Percutaneous Coronary Intervention; STEMI-RADIAL, Radial vs. Femoral Approach in Primary Percutaneous Coronary Intervention.

revascularization, including PCI of the infarct culprit artery. For patients with cardiogenic shock, there is higher mortality with a routine approach of performing nonculprit PCI of all significant lesions, so it should not be performed in that setting.[18] Other aspects of management of cardiogenic shock, including use of inotropes and mechanical support, are discussed in detail in a recent comprehensive review.[19]

TABLE 2. Changes in Guideline Recommendations for Multivessel vs. Culprit Artery–Only PCI in Patients With STEMI From the 2015 Focused Update to the STEMI Guidelines

2013 STEMI Guideline Recommendations	**Class III: Harm** PCI should not be performed in a non-infarct artery at the time of primary PCI in patients with STEMI who are hemodynamically stable
2015 STEMI Guideline Recommendations	**Class IIb: Weak** PCI of a non-infarct artery may be considered in selected patients with STEMI and multi-vessel disease who are hemodynamically stable, either at the time of primary PCI or as a planned staged procedure
Changes in Recommendations	Recommendation changed from Class III to class IIb2. Multi-vessel PCI can occur at the time of culprit artery PCI or later in the hospital course

Aspiration Thrombectomy: The 2013 ACCF/AHA Guideline for the Management of STEMI gave a Class IIa recommendation for routine manual aspiration before primary PCI in patients presenting with STEMI,[12] but this has been changed to a Class III level of evidence A recommendation in the 2017 ESC Guidelines. This is due to recent evidence from 2 RCTs that have demonstrated no difference in outcomes for those patients undergoing aspiration thrombectomy. The Thrombus Aspiration During ST-Segment Elevation Myocardial Infarction (TASTE) trial enrolled 7244 patients and found no differences in 30-day or 1-year death, reinfarction, stent thrombosis, target lesion revascularization, or a composite of major adverse cardiac events between those patients who received aspiration thrombectomy before primary PCI versus primary PCI only.[20] The Trial of Routine Aspiration Thrombectomy With PCI Versus PCI Alone in Patients With STEMI (TOTAL) trial enrolled over 10,000 patients with similar results to the TASTE trial, and a statistically significant trend toward an increased rate of stroke in the aspiration thrombectomy group.[21] Thus, routine aspiration should not be performed.

Optimal Care for the Patient with NSTEMI in the Cardiac Catheterization Laboratory: Whereas the timing of revascularization for patients with STEMI usually involves immediate coronary angiography, the timing of revascularization for patients with NSTEMI may vary with the risk profile of the patient. The 2014 AHA/ACC Guidelines for the Management of Patients with Non-ST-Elevation Acute Coronary Syndrome recommends an ischemia-driven approach if the patient is low risk [ie, Thombolysis in Myocardial Infarction (TIMI) score 0 or 1 or Global Registry of Acute Coronary Syndrome (GRACE) score <109] or an early invasive approach (ie, coronary angiography within 24 hours) for patients with ongoing changes in troponin or GRACE score >140 (estimated rate of in-hospital death >3%).[22] Before deciding on the strategy of coronary angiography, the patient's comorbidities

TABLE 3. Management Strategies for Patients Presenting With NSTEMI by Presenting Signs and Symptoms Adapted From the 2015 Focused Update to the STEMI Guidelines

Management Strategy	Patient Symptoms and Presentation
Immediate Invasive (within 2 hours)	• Refractory angina • Signs or symptoms of heart failure or new or worsening mitral regurgitation • Recurrent angina despite maximal medical therapy • Sustained ventricular tachycardia or ventricular fibrillation
Ischemia-guided	• Low risk (Thombolysis in Myocardial Infarction [TIMI] score 0 or 1 or Grace score <109) • Low-risk troponin-negative female patients • Patient or clinician preference in the absence of high risk factors
Early invasive (within 24 hours)	• None of the above, but Grace score >140 • Temporal change in troponin • New or presumably new ST depression
Delayed invasive (within 25-72 hours)	• None of the above but diabetes mellitus • Renal insufficiency (glomerular filtration rate [GFR] < 60 ml/min/1.73 m²) • Left ventricular systolic dysfunction (EF <40%) • Early postinfarction angina • Percutaneous coronary intervention within previous 6 months • Prior coronary artery bypass grafting • Grace Risk Score 109-140, TIMI score ≥ 2

should be considered and, if extensive (eg, advanced chronic kidney disease, advanced malignancy, or hepatic failure), coronary angiography should be potentially delayed or not performed. Table 3 demonstrates the various strategies that may be employed in patients with NSTEMI.

Antithrombotic Therapy in Patients with NSTEMI: Many of the antithrombotic treatment strategies used in the catheterization laboratory are similar between patients with NSTEMI and STEMI presentations. On presentation to the emergency department or diagnosis of NSTEMI, the patient should be loaded with 325 mg non–enteric-coated aspirin. Patients should then be loaded with clopidogrel 600 mg (300 mg for patients 75 years of age or older), prasugrel 60 mg, or ticagrelor 180 mg. If the patient was already taking clopidogrel before diagnosis of NSTEMI, the patient should be reloaded with clopidogrel before undergoing coronary angiography. Although the guidelines do not recommend for or against reloading of ticagrelor or prasugrel before coronary angiography, it is generally advised to reload these antiplatelet agents if the patient was already taking them, given the rates of medication noncompliance.

It is a Class IIb recommendation to administer a glycoprotein IIb/IIIa inhibitor, such as eptifibatide or tirofiban, in addition to dual antiplatelet therapy for high-risk patients treated with an early invasive strategy. Unfractionated heparin, enoxaparin, and bivalirudin all receive Class I recommendations for use during coronary angiography in patients with NSTEMI. Given the evidence for increased risk of catheter thrombosis during coronary angiography when fondaparinux is used as the sole anticoagulant, fondaparinux is not recommended for use during coronary angiography.[23]

Access Considerations: As mentioned in the previous section on access considerations, the literature on the benefit of transradial access in patients with NSTEMI is somewhat contradictory. However, several trials have demonstrated reduction in bleeding and vascular complications with the use of transradial access in patients with NSTEMI (Table 1).

Type of Stent: Although the duration of P2Y12 inhibitor therapy has been longer with drug-eluting stents than bare metal stents in clinical trials, data with current-generation drug-eluting stents show similar or lower rates of stent thrombosis with drug-eluting stents than with bare metal stents. Therefore, current guidelines recommend routine use of drug-eluting stents for patients with NSTEMI and STEMI.[11]

Multivessel PCI: Patients with NSTEMI who have undergone multivessel PCI have not demonstrated an increased risk of major adverse cardiac events when compared with patients who underwent culprit artery–only PCI.[24,25] Additionally, patients with NSTEMI who underwent multivessel PCI did not have an increased risk for subsequent revascularization. Multivessel PCI at the time of coronary angiography for NSTEMI carries a Class IIb recommendation.

If the patient is found to have left main or multivessel disease requiring CABG at the time of coronary angiography, aspirin should be continued, and P2Y12 inhibitor therapy should be discontinued. It is a Class I indication to discontinue clopidogrel and ticagrelor for at least 5 days and prasugrel for 7 days before elective CABG, although it may be reasonable to proceed with CABG as early as 3 days after stopping ticagrelor.[26] If patients have ongoing anginal symptoms or are hemodynamically unstable, there is a Class IIb recommendation to perform CABG earlier than 5 days after discontinuation of clopidogrel and ticagrelor or 7 days after prasugrel.

Care for the ACS Patient in the Coronary Care Unit: Care for the patient with ACS before and immediately after coronary angiography and PCI should include initiating evidence-based medications and education about lifestyle and medication changes. Either during coronary angiography or after PCI, the patient will undergo a ventriculogram in the catheterization laboratory or an echocardiogram with documentation of left ventricular ejection fraction. An assessment of comorbid risks should be examined, including evaluation of hemoglobin A1c. Close monitoring for hemodynamic instability and electrical instability on telemetry should be maintained.

Several medications should be considered and initiated early during the hospital course in the cardiac intensive care unit. If the patient has a left ventricular ejection fraction <40%, hypertension, diabetes, or chronic kidney disease, an angiotensin-converting enzyme inhibitor should be initiated and titrated up early during the hospital course. If there is a history of angiotensin-converting enzyme inhibitor intolerance, angiotensin receptor blockers may be considered instead, using either valsartan or candesartan. β-Blocker therapy should also be initiated early in the hospital course, as long as the following signs or features are not present: cardiogenic shock, low-output state, significantly prolonged PR interval, or second- or third-degree heart block. For patients with known heart failure that is stable, the use of metoprolol succinate, carvedilol, or bisoprolol is recommended. Unless the patient has previously been intolerant to statins, high-intensity statins, including atorvastatin 40–80 mg daily or rosuvastatin 20–40 mg daily, are recommended. For the patient with ongoing complaints of chest discomfort after PCI without concern for worsening ischemia, long-acting nitrates and calcium channel blockers can be used to help control these symptoms.

Importantly, a focus on mitigating risk factors, including tobacco use, uncontrolled type II diabetes, and medication noncompliance, is important early in the hospital course. Counselors should meet to discuss strategies for smoking cessation with the patient, including consideration of the use of varenicline.[27] A diabetes management team might be helpful to implement strategies to reduce cardiovascular risk related to diabetes. If the patient is underinsured, lacks financial resources, or is considered higher risk for medication nonadherence, it may be helpful for social workers to meet with the patient and family to discuss ways to obtain medications or obtain hospital or pharmaceutical support for medications. The importance of outpatient follow-up and cardiac rehabilitation should be emphasized to the patient. Although these discussions may occur once the patient has moved out of the coronary care unit, it is critical that they begin early and are emphasized multiple times during the post-ACS period.

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DEVELOPING OUTSTANDING POSTDISCHARGE CARE PROGRAMS FOR ACUTE CORONARY SYNDROME

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Introduction: The inpatient management of acute coronary syndrome (ACS) has become increasingly concise with the adoption of earlier invasive approaches and shorter length of stay. According to the National Cardiovascular Data Registry, the median length of stay following primary percutaneous coronary intervention for ST-elevation myocardial infarction is now ≤2 days. Implementation of algorithmic ACS care with programs like "Get With the Guidelines" does not reduce adherence to evidence-based measures, even with shorter length of stay.[1] Thus, the window of time available to provide the patient and caregivers with education and elements of care coordination is smaller. Additional factors contributing to transition challenges in ACS include the complexity of the medication regimen, dietary and lifestyle modification recommendations, tobacco dependence treatment, and management of previously unidentified or uncontrolled comorbidities (such as hypertension or diabetes). The objective of ACS therapy is to restore function to normal or near-normal levels, reduce risk of subsequent events, and facilitate secondary prevention through aggressive control of risk factors.[2]

Therefore, in addition to optimizing triage and emergency/acute care, achieving excellent outcomes for ACS patients also depends on providing a safe transition to the post–acute care setting by establishing enhanced discharge processes and ensuring adequate outpatient planning and support. Key elements to providing a successful ACS discharge and establishing best practices in outpatient care will be addressed here (Fig. 1). These elements form the basis for the ACS transition-of-care program adopted at the University of Kentucky (UK) Medical Center, named KATS PLEDGE (KY Adherence to PharmacoTherapy System: Program to Lead, Educate and Deliver Goal-Directed Care Effectively), which will be used here as an example.

Discharge Preparation: To provide optimal continuity of care for ACS, discharge planning must begin on admission. Existing or newly diagnosed comorbid conditions, social concerns, and other factors that require more complex discharge planning can usually be identified early and hence can be addressed sooner rather than later. Accurate medication history and reconciliation, assessment of medication adherence, prescribing of evidence-based and streamlined pharmacotherapy, multilevel effective communication, and patient education about disease and therapy are key elements of discharge preparation.

An accurate and complete medication history can provide insight into previous history and medication allergies or intolerances and prevent unnecessary medication changes. For example, it may be counter-productive and confusing to change a high-potency statin or an angiotensin receptor blocker from one brand to another if patients confirm their home medications are well tolerated and affordable. It is also important to have an accurate previous home regimen to educate patients on discontinued medications or changed doses upon discharge. Institutions use a multitude of approaches to obtain medication histories. Studies show that assigning accountability and involving pharmacy personnel (technicians or pharmacists) improves documentation and accuracy.[3,4]

Adherence is a complex behavior, and it is a well-documented problem in cardiovascular disease management. As the complexity of a medical regimen increases, adherence declines. It is not unusual for a patient with newly diagnosed ACS to be admitted on no medications and discharged soon thereafter with "polypharmacy." Therefore, it is important to consider the patient's health literacy and past medication adherence to identify and address barriers to adherence. A simple 3-question tool can rapidly identify inadequate functional health literacy: (1) How often do you have difficulty understanding written information about your medical condition? (2) How often do you have someone help you read written medical information? (3) How confident are you at filling out medical forms by yourself?[5] The 8-question MORISKY assessment (Table 1) has also been validated as a tool to evaluate medication adherence.[6] Utilizing these tools allows improved understanding of a patient's health literacy and barriers to adherence, which can help with providing appropriate targeted education. Both disease and medication education should begin immediately and be reinforced throughout the hospitalization and into post–acute care settings. Understanding and improving patients' perceptions about taking their cardiac medications will help to ensure that patients will take the evidence-based regimens provided.[7,8]

Many resources exist to help health systems provide evidence-based therapy. Education regarding and systematic implementation of current treatment guidelines, reviewing and updating practices based on cutting-edge clinical trials, solidification of practice through development of hospital protocols and pathways, and development of multidisciplinary patient care teams can help ensure that patients are prescribed the best possible pharmacologic and

FIGURE 1. Key elements of successful discharge and post–acute care follow-up.

TABLE 1. Modified 8-Item MORISKY Assessment

1.	Do you sometimes forget to take your medications?
2.	Over the past two weeks, were there any days you did not take your medicine?
3.	Have you ever cut back or stopped taking your medication without telling your doctor because you felt worse when you took it?
4.	When you travel or leave home, do you sometimes forget to bring along your medications?
5.	Did you take your medication yesterday?
6.	When you feel like your disease is under control, do you stop taking your medicine?
7.	Do you ever feel hassled about sticking to your medication regimen?
8.	How often do you have difficulty remembering to take your medicine?

nonpharmacologic therapies. Although implementing standardized protocols is useful in adhering to evidence-based approaches and reducing variation, it is important to understand and consider the uniqueness of every patient's clinical situation and to adjust accordingly.

Communication between the medical team, the patient, and other caregivers and providers is of critical importance. Changes made to previous home therapy should be clearly relayed to all parties (patient, caregivers, primary care and referring providers, and home pharmacists). Communication can prevent unnecessary confusion and improve adherence and continuity. Discontinuing old prescriptions at the patient's pharmacy will prevent drug interactions, duplication of therapy, and again improve continuity.

Patient education should also begin early in the hospital stay. Armed with an understanding of the patient's health literacy and given the widespread availability of multimedia tools, education can be truly dynamic. For example, at UK HealthCare, the patient's disease (eg, atherosclerosis, risk factors, and ACS) and therapy (eg, coronary stenting and lipid-lowering and antiplatelet agents) are explained to patients utilizing short video clips displayed on tablet computers in the preparation and recovery area of the catheterization laboratory. Medication education is provided each time the patient is given a medication to take, through tablet videos and written communication, which is reviewed for optimal local health literacy levels. More comprehensive medication education is provided before discharge and is described in more detail later.

Enhanced Discharge Process: Enhanced discharge processes are intended to facilitate patient education, improve effective communication, and ensure safe transition of care. Several comprehensive tools have been shown to improve multiple aspects of patient care, including patient medication understanding, satisfaction, and adherence, and in some cases, these tools have been shown to improve outcomes by reducing readmission. One such tool is Boston University's Project Re-Engineered Discharge (Project RED), which has been widely imitated.[9] Armed with accurate incoming medication history and reconciliation on admission, facilitation of comprehensive discharge reconciliation is a fundamental component of an enhanced discharge process. At UK HealthCare, ACS patients' discharge medication reconciliation is facilitated by cardiovascular clinical pharmacists and finalized by discharging physicians or advanced practice providers. This double check provides much needed redundancy given the quick patient turn over and multiple medication changes. Providing patients with user-friendly tools, such as discharge medication schedules and written instructions regarding which medications have been changed or discontinued, is vitally important (Fig. 2). Other tools, such as pill boxes and discharge prescription services, may further aid patients and improve adherence.

Although patient and caregiver education should begin early and have built in redundancy, discharge education remains extremely important. As stated earlier, this should be in the context of a more comprehensive discharge process aimed at ensuring patient involvement, adherence, and safe transition from inpatient to outpatient status. Aspects related to diet, exercise, and risk factor control education are typically provided by cardiovascular nurses and dedicated educators and/or nutritionists at any opportunity during the typically short hospital stay. At UK Healthcare, education related to pharmacotherapy is provided by cardiology clinical pharmacists or their extenders (pharmacy interns, students, and residents). Pharmacists are uniquely trained to provide education to patients on their medications, and their interventions have been shown to increase identification of medication errors and improve patient adherence.[10] Although resource intensive, it is important that pharmacist resources be allocated to patient education for particularly high-risk patient populations, such as those with ACS. Any medication education session should include review of medication indications (eg, patients who take

Medications You Should Take

Medication name	Morning	Noon	Evening	Bed Time	Additional Instructions
					Instructions
Aspirin 81 mg oral tablet - By mouth (Also known as Low dose ASA, Aspirin low strength, Bayer low strength)	1 tab(s)				1 tab(s) orally 1 time a day
Atorvastatin 80 mg oral tablet - By mouth (Also known as Lipitor)				1 tab(s)	1 tab(s) orally 1 time a day (at bedtime)
Carvedilol 6.25 mg oral tablet - By mouth (Also known as Coreg)	1 tab(s)		1 tab(s)		1 tab(s) orally 2 times a day
Lisinopril 5 mg oral tablet - By mouth (Also known as Zestril, Prinivil)	1 tab(s)				1 tab(s) orally 1 time a day
Ticagrelor 90 mg oral tablet - By mouth (Also known as Brilinta)	1 tab(s)		1 tab(s)		1 tab(s) orally 2 times a day
Vitamin D3 1000 intl units oral tablet - By mouth (Also known as Vitamin D3, D 1000 IU, D3 1000)	1 tab(s)				1 tab(s) orally 1 time a day
Nitroglycerin 0.4 mg sublingual tablet - Under tongue (Also known as Nitrostat, Nitroquick)					1 tab(s) under tongue every 5 minutes, as needed for chest pain

If you have medications at home that are not on this list:
- Call the doctor that gave you the medicine
- Share this list with your doctor
- Ask the doctor if you should stop taking them or keep taking them

FIGURE 2. Example discharge medication schedule from the UK HealthCare.

TABLE 2. Ten Elements of Competence for Using Teach-Back Effectively

1. Use a caring tone of voice and attitude.
2. Display comfortable body language and make eye contact.
3. Use plain language.
4. Ask the patient to explain back, using their own words.
5. Use non-shaming, open-ended questions.
6. Avoid asking questions that can be answered with a simple yes or no.
7. Emphasize that the responsibility to explain clearly is on you, the provider.
8. If the patient is not able to teach back correctly, explain again and re-check.
9. Use reader-friendly print materials to support learning.
10. Document use of and patient response to teach-back.

statins post-ACS are less likely to experience another myocardial infarction), potential adverse drug reactions and importance of adherence (particularly with dual antiplatelet therapy [DAPT]). The "teach-back" technique (also referred to as "show me") is an evidence-based education process that ensures patients have gained understanding of vital information.[11] It is not meant to "quiz" the patient, but with practice and dedication to mastering this approach it may be employed naturally to patient interactions. In general, patients are simply asked to explain, in their own words, what they need to know or how to take a medication. This technique provides a mechanism for confirming either proper understanding or miscommunication or suboptimal understanding that requires re-education. Essential elements of this evidence-based education technique and the tools to learn and implement it can be found at teachback-training.org (Table 2).

An additional component of enhanced discharge processes that has been fully implemented at UK HealthCare is a dedication to ACS patients leaving with all their medications in hand via discharge prescription services. This is particularly important for patients prescribed new DAPT, because it has been well demonstrated that delays in filling contribute to increased cardiovascular morbidity and mortality.[12] In the case of clopidogrel, it has been shown that at least 1 in 6 patients delays filling their prescription with an average of 3 days delay.[13] Although few studies have addressed whether providing DAPT to patients before discharge can reduce this risk, it is widely accepted that the highest risk of subsequent events (such as stent thrombosis) is concentrated in the first month. Providing medications without co-payment post–myocardial infarction also has a beneficial impact on adherence. In the Post-Myocardial Infarction Free Rx Event and Economic Evaluation (MI FREEE) trial, the discharge statin, β-blocker, and renin–angiotensin–aldosterone inhibitors were provided at no cost to study patients. With a major limitation of not including antiplatelet therapy, the service did not reduce major cardiovascular events; however, there was an improvement in adherence and a reduction in overall patient costs.[14] This trial hints at the importance of DAPT, but it also clearly shows the complexity of medication adherence and the need for a multifaceted and individualized intervention when tackling issues of nonadherence.

Another advantage of discharge prescription delivery is that it allows more targeted, consistent, and thorough education (eg, showing the patients their medication or filling pill boxes). As previously mentioned, at UK HealthCare cardiovascular trained clinical pharmacists provide patient discharge medication education. Filling prescriptions in house allows the team to identify important financial barriers, ensure prior authorizations, help enroll patients in assistance programs, and/or adjust the pharmacotherapy regimen with the coordinated expertise of clinical pharmacists and cardiologists. There is also a potential financial benefit to the health system associated with outpatient pharmacy revenue generation (both on discharge and with new patient recurring volumes). Over 90% of ACS patients consent to participate in this program. Once patients opt in, a standardized prescription form is utilized by the team at the time of hospital discharge and completion of discharge reconciliation (Fig. 3). It is advisable that institutions that provide this service emphasize effective patient communication regarding refills and/or transfer of prescriptions to the previously established outpatient pharmacy. Such education should be provided both verbally and in written instructions. In patients with particularly low literacy, mail order service or proactive communication with their community pharmacist to transfer prescriptions may be helpful.

Finally, care coordination is a vital component of the optimal discharge process. Providing patients with adequate information about follow-up plans (eg, appointment dates and times, follow-up locations, any referrals, home resources, and study results) before discharge can help ensure continuity post-discharge. Care coordination should also include ensuring adequate documentation and communication of care plans between inpatient and outpatient care providers, as well as specialists, primary care providers, pharmacy providers, etc.

One important aspect of coordination is encouraging and facilitating enrollment in cardiac rehabilitation programs. Evidence of the valuable role of rehabilitation programs is plentiful, and it is a recommendation of the national guidelines and a quality metric for ACS care.[2,15] In tertiary care centers, where ACS patients are frequently transferred from community and/or rural hospitals, it is important to identify and refer patients to cardiac rehabilitation centers closest to their residence. Providing patients with such referrals and contact information for follow-up is an important component of the care coordination process.

At UK HealthCare, the inpatient clinical pharmacists and nurse discharge coordinators leave a detailed note in the electronic record documenting patient-specific pharmacotherapy discussions and information obtained during the discharge counseling session. The consistent and thorough documentation facilitates improved postdischarge care.

Postdischarge Care: Individual components of the post–acute care follow-up have been widely employed with mixed clinical outcome findings. This is especially true of the 24–48 hours postdischarge phone call. Although a scripted and appropriately managed call can provide an opportunity to answer patient questions, ensure prescriptions have been filled (if discharge prescriptions were not provided), and possibly prevent early readmission by reassurance of clinical status, the mixed results make full implementation of this single intervention challenging for resource justification. The success of follow-up calls can be improved when combined with home visits and/or early discharge face-to-face clinic visits. At UK HealthCare, all patients are called within 48 hours by discharge nurses based on care units. Recently, the United Kingdom started a home visit program following discharge, which leverages the outreach of the home hospice teams, allowing them to double as transition-of-care nurses after receiving training in specific diagnoses that are known for higher readmission rates (such as heart failure and ACS). However, the majority of patient support occurs at an early (within 7 days) face-to-face transition-of-care clinic visit with a cardiovascular clinical pharmacist.

In the UK care model, the cardiovascular clinical pharmacist is credentialed and privileged to provide comprehensive medication therapy management and patient education on behalf of the interventional cardiologists. The office visit provides many elements of support for the patient with a clear emphasis on education and medication therapy management. Table 3 provides an overview of services provided in this clinic visit. Patient encounters last an average of 45 minutes. If a clinical concern is identified (eg, procedural complication or serious adverse event), immediate support is provided by interventional cardiologists and/or advanced practice providers.

Given that a large portion of early and preventable readmissions are medication-related, the follow-up at UK HealthCare is pharmacy-driven

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Patient name: _____
DOB: _____
MRN: _____

KATS PLEDGE

KY Adherence to pharmacoTherapy System: Program to Lead, Educate, and Deliver Goal-directed care Effectively

This is a legal prescription form. Please complete and sign this form for ALL but ONLY patients who have received Percutaneous Coronary Intervention.

Gill Heart Institute
800 S. R ose St., Suite GlOO
Lexington, KY 40536
Phone: 859-323-xxxx
Fax: 859·323-xxxx

☐ **John Doe, MD KY License #00000**
☐ **Jane Doe, MD KY License #11111**
☐ **John Smith, MD KY License #22222**
☐ **Jane Smith, MD KY License #33333**
☐ **John Rich MD KY License #44444**
☐ **Jane Rich, MD KY License #55555**

*Check the interventional cardiologist above and add your prescriber information below the signature
Core secondary prevention medicines will be filled and delivered to patient free of charge at time of hospital discharge.

Select below (unless contraindication):
☐ Aspirin 81 mg po daily #30, 11 refills

Select one below:
☐ Ticagrelor 90 mg po twice daily #60, 11 refills
☐ Clopidogrel 75 mg po daily #30, 11 refills

Select one below (and appropriate dose):
☐ Atorvastatin 80 me po daily at bedtime #30, 11 refills
☐ Atorvastatin 20 mg po daily at bedtime #30, 11 refills (lower dose option for patients >75 yo)
☐ Pravastatin 80 mg po daily at bedtime #30, 11 refills

Select one below (and appropriate dose):
Metoprolol tartrate (Lopressor):
☐ 12.5 mg po twice daily #60, 11 refills
☐ 25 mg po twice daily #60, 11 refills
☐ 50 mg po twice daily #60, 11 refills
☐ 100 mg po twice daily #60, 11 refills
Carvedilol:
☐ 3.125 mg po twice daily #60, 11 refills
☐ 6.25 mg po twice daily #60, 11 refills
☐ 12.5 mg po twice daily #60, 11 refills
☐ 25 mg po twice daily #60, 11 refills

Select if indicated: DMII, LVSO (EF<40%), HTN or CRI (and appropriate dose):
Lisinopril:
☐ 2.5 mg po daily #30, 11 refills
☐ 5 mg po daily #30, 11 refills
☐ 10 mg po daily #30, 11 refills
☐ 20 mg po daily #30: 11 refills
☐ 40 mg po daily #30, 11 refills

Select if needed:
☐ SL Nitroglycerin 0.4 mg, place one tablet under tongue as needed for chest pain, #25, 3 refills

Additional mediations may be electronically prescribed. Those medications will be the financial responsibility of the patient and not covered under the KATS PLEDGE program.

Delivery service available for prescriptions received M-F 8:00am-7:00pm, Sat 9:00am-4:30pm, Sun 1:00pm - 4:30pm.
If you have questions about delivery, please call the Meds-to-Beds team at 859-218-xxxx.

MD/APP Signature (print & sign): _____ Date/Time: _____
KY Lic #:
Pager #:

FIGURE 3. Example ACS discharge prescription form used by the UK HealthCare to ensure accurate prescribing of evidence-based therapies and discharge prescription services to all ACS patients.

and, although multifaceted, focuses largely on identification and resolution of medication-related problems (MRP). MRPs are defined as undesirable events experienced by patients that involve or are suspected to involve their drug therapy. Further categorization of MRPs and corresponding examples that are specific to ACS are shown in Table 4. For example, it is important to reassure patients who feel dyspneic after beginning ticagrelor therapy that this side effect frequently subsides within days and that the benefits of effective platelet inhibition outweigh the transient self-limited side effect. When angiotensin-converting enzyme inhibitors are started in the hospital in patients with chronic kidney disease, it is important to check renal function and electrolytes within 7–10 days.

Care coordination and appropriate handover of patient care is also provided in the ACS transitional care management clinic at the United Kingdom. Ensuring that patients have follow-up with their primary care providers, are established with cardiologists, have been referred for cardiac rehabilitation, and have care plans for comorbidity management is vital to their success.

TABLE 3. Activities in ACS Transitional Care Management Clinic

Activity	Description
Hospitalization Review	Provide patient/family clarity on events, interventions, future directions (e.g., staged percutaneous coronary intervention)
General Assessment at Home	Identify angina or heart failure symptoms and/or medication-related problems
Medication Reconciliation: with review of prescription and over-the-counter meds utilizing teach-back	Clarify home medications not previously addressed, re-direct on education of new medications (indications, potential adverse drug experiences, importance of adherence), update accurate list in electronic medical record, provide patient a new updated list/schedule, identify and address medication-related problems
Patient Assessment: vitals, medication related problems, catheter access site, etc.	Adjust medications for blood pressure or heart rate (high or low), assess heart failure symptoms (adjust diuretic, medication titration), identify adverse drug experiences and adjust therapy
Laboratory Assessment	Monitor pharmacotherapy (serum creatinine, potassium, etc.) and/or follow up needs from inpatient (serum creatinine, hemoglobin/hematocrit, thyroid stimulating hormone)
Tobacco Dependence Education	Re-assess willingness to quit, adjust supportive pharmacotherapy, referral
Cardiac Rehabilitation	Confirm or make referral, discuss program goals
Schedule Re-assessment of Left Ventricle	Follow up with Cardiology/Electrophysiology for implantable cardioverter-defibrillator (ICD) placement if necessary
Dietary Invention	Discuss role of sodium in hypertension and low-sodium/low-fat diets, as well as plant-based and Mediterranean diets
Activity Education	Discuss return to work, exercise, sex, etc.
Follow Up Planning	Establish long-term cardiologist, arrange primary care physician follow up (communication), refer for specialists as needed (e.g., endocrinology, psychology, social worker, tobacco treatment specialists, nephrologist)

TABLE 4. Classification of MRP

Medication-Related Problem	Description/Example
Untreated medical condition	Patient meets criteria for aldosterone antagonist but not prescribed at discharge
Patient taking unnecessary drug (medication without indication)	Patient prescribed proton pump inhibitor without clear indication
Incorrect medication for patient's condition or age	Patient has low ejection fraction but is not on an evidence-based beta-blocker
Patient not taking medication correctly	Patient taking ticagrelor or carvedilol once daily
Correct medication but dose too low (subtherapeutic)	Patient started on low-dose angiotensin converting enzyme inhibitor for post-acute coronary syndrome care and hypertension, but blood pressure remains uncontrolled
Correct medication but dose too high (overdosage)	Patient on apixiban for atrial fibrillation but has low glomerular filtration rate and requires dose reduction
Adverse drug reaction	Patient experiencing rash with P2Y12 inhibitor or myopathy with statin therapy
Drug interactions (with drug or food)	Patient on phenytoin for seizures and prescribed ticagrelor for acute coronary syndrome (an absolutely contraindicated drug interaction)
Failure to receive a necessary medication	Patient recommended to take an over-the-counter proton pump inhibitor for gastrointestinal prophylaxis and has not picked up at pharmacy

Also, education with teach-back on lifestyle modifications ensures appropriate emphasis on all aspects of secondary prevention.

Conclusions: Providing optimal continuity for complex disease states, such as ACS, has been extensively evaluated. Individual interventions, such as follow-up phone calls or medication reconciliation, have resulted in variable success. However, when multiple interventions are combined and multidisciplinary team members participate, outcomes are consistently improved. Implementation of the components discussed here, which focus on individualizing education, identifying and eliminating barriers to adherence, and preventing medication-related problems throughout the hospital stay and in the post–acute care setting, can ensure that patients have the best chance at successful outcomes.

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