Risk Factors

Prognostic Impact of Hyperglycemia in Nondiabetic and Diabetic Patients With ST-Elevation–Myocardial Infarction: Insights From Contrast-Enhanced Magnetic Resonance Imaging

Summary: Previous studies have suggested that hyperglycemia on admission is a risk factor for increased mortality in patients with acute ST-elevation–myocardial infarction (STEMI). However, data regarding the relationship between hyperglycemia and myocardial damage in STEMI are scarce. This largest cardiac magnetic resonance study to date evaluating the relationship of diabetes mellitus status and elevated glucose levels on admission on myocardial damage in STEMI patients reperfused by primary percutaneous coronary intervention has 2 essential findings: (1) STEMI patients with pre-existing diabetes mellitus are at greater risk for major adverse cardiovascular events despite having similar infarct sizes and extent of reperfusion injury than patients without known diabetes mellitus. (2) Elevated glucose levels on admission are associated with greater myocardial damage (larger infarcts, more pronounced reperfusion injury, left ventricular dysfunction) and an increased risk of clinical events at long-term follow-up. However, hyperglycemia was a stronger indicator of myocardial injury in STEMI patients without previously recognized diabetes mellitus than in those with established diabetes mellitus. Thus, the authors' study confirms and expands previous findings by demonstrating that the amount of myocardial injury does not explain the substantially higher mortality rates in diabetic patients with STEMI. Moreover, the authors could demonstrate that the relationship between hyperglycemia and myocardial damage is different in STEMI patients with and without known diabetes mellitus.

Conclusions: The higher mortality rate in diabetic versus nondiabetic STEMI patients is not explained by more pronounced myocardial damage. Hyperglycemia on admission is associated with greater myocardial injury and an increased risk of major adverse cardiovascular events at long-term follow-up. However, hyperglycemia has a stronger relationship to myocardial injury in nondiabetic compared with diabetic patients.

Polyvascular Disease and Long-Term Cardiovascular Outcomes in Older Patients With Non–ST-Segment–Elevation Myocardial Infarction

Summary: Prior studies have shown that patients with non–ST-segment-elevation myocardial infarction and polyvascular disease (prior peripheral arterial disease, cerebrovascular disease, or both in addition to coronary artery disease) have worse in-hospital and intermediate-term (6–12 months) outcomes after their acute myocardial infarction. There seems to be a gradation of risk with the number of affected arterial beds such that patients with atherosclerotic involvement of all 3 arterial beds have worse short-term and intermediate-term outcomes compared with those with dual-bed involvement, whereas those with coronary bed involvement alone have the lowest risk. The present analysis extends findings of prior studies to the long-term setting by demonstrating in a contemporary cohort that older patients with non–ST-segment–elevation myocardial infarction and polyvascular disease have very high rates of mortality (>50% at 3 years) and composite ischemic end points compared with patients without polyvascular disease. The risk of long-term outcomes increases incrementally with increasing number of arterial beds involved. Despite increased long-term risk associated with polyvascular disease, the use of guidelines-based recommended therapies is modest.

Conclusions: Among older patients with non–ST-segment–elevation myocardial infarction, those with polyvascular disease have substantially higher long-term risk for recurrent events or death. Future studies targeting greater adherence to secondary prevention strategies and novel therapies are needed to help to reduce long-term cardiovascular events in this vulnerable population.

Frailty Is Independently Associated With Short-Term Outcomes for Elderly Patients With Non–ST-Segment Elevation Myocardial Infarction

Summary: There is sometimes a disconnect between biological and chronological age, and this has been identified as a major obstacle in applying evidence-based treatments. For the large and growing population of elderly patients with cardiovascular disease, it is important to identify clinically relevant measures of biological age and their contribution to risk. Frailty is an emerging concept in medicine denoting increased vulnerability and decreased physiological reserves. Frailty instruments have thus far been validated and used mainly in a geriatric context, in which frailty stratification has been shown to be associated with a patient’s risk of death and need for institutional care. The authors analyzed the manner in which the variable frailty is associated with short-term outcomes for elderly non–ST-segment elevation myocardial infarction patients. Frailty is strongly and independently associated with risk for inhospital mortality, 1-month mortality, prolonged hospital care, and the primary composite outcome (all-cause death, myocardial reinfarction, revascularization due to ischemia, hospitalization for any cause, major bleeding, stroke/transient ischemic attack, and need for dialysis up to 1 month after inclusion). The combined use of frailty and comorbidity may constitute an ultimate risk prediction concept
for cardiovascular patients with complex needs. In clinical decision making, frailty could function as a tool in estimating the patient’s benefit–risk ratio associated with a treatment, including the expected lifetime for individual patients and its relation to the overall yield of a treatment. It could enhance decision making in regard to whether to focus on prognostic or symptomatic treatment.

**Conclusions:** Frailty is strongly and independently associated with in-hospital mortality, 1-month mortality, prolonged hospital care, and the primary composite outcome. The combined use of frailty and comorbidity may constitute an ultimate risk prediction concept in regard to cardiovascular patients with complex needs.

**Prognostic Value of Admission Glycosylated Hemoglobin and Glucose in Nondiabetic Patients With ST-Segment–Elevation Myocardial Infarction Treated With Percutaneous Coronary Intervention**

**Summary:** Measurement of admission glucose and hemoglobin A1c (HbA1c) in acute myocardial infarction may identify patients with disturbed glucose metabolism and an increased risk for adverse outcome. Although HbA1c and glucose are related, they can differentiate between mechanisms of adverse outcome. Admission glucose is related to increased hemodynamic stress, whereas HbA1c identifies patients with higher long-term cardiovascular risk, possibly by abnormal long-term glucose levels. Early identification of these patient groups enables the initiation of specific intervention strategies and may help us develop strategies to improve prognosis in these high-risk patient groups. This is of particular importance because there is a global increase in the number of patients with cardiovascular disease with underlying insulin resistance, prediabetes, and overt diabetes mellitus. Both glucose and HbA1c should be measured in patients admitted with ST-segment–elevation myocardial infarction.

**Conclusions:** In nondiabetic patients with ST-segment–elevation myocardial infarction, both elevated admission glucose and HbA1c levels were associated with adverse outcome. Both of these parameters reflect different patient populations, and their association with outcome is probably due to different mechanisms. Measurement of both parameters enables identification of these high-risk groups for aggressive secondary risk prevention.

**Assessment of Infarct Size**

**Prognostic Value and Determinants of a Hypointense Infarct Core in T2-Weighted Cardiac Magnetic Resonance in Acute Reperfused ST-Elevation–Myocardial Infarction**

**Summary:** CMR can provide a wide range of prognostic information in acute STEMI by detecting infarct size, MO, and myocardial salvage. Additionally, a hypointense core of infarcted myocardium in T2-weighted CMR has been used as a noninvasive marker for IMH. However, the clinical significance of such findings has not yet been established. The present study is the largest study thus far to assess determinants and the prognostic significance of hypointense infarct cores in T2-weighted CMR. A hypointense core within the AAR of reperfused infarcted myocardium in T2-weighted CMR is a frequent finding in reperfused STEMI patients and is closely related to infarct size, impaired LV function, and late MO. Moreover, hypointense infarct cores are a strong indicator of MACE at 6-month clinical follow-up and may serve as a new CMR marker of severe reperfusion injury. However, further validation is necessary to ascertain the relationship conclusively between hypointense infarct cores and IMH, and large, multicenter studies are warranted to further investigate the prognostic significance of hypointense infarct cores.

**Conclusions:** A hypointense infarct core within the area at risk of reperfused infarcted myocardium in T2-weighted CMR is closely related to infarct size, microvascular obstruction, and impaired left ventricular function, with subsequent adverse clinical outcome.

**Right Ventricular Injury in ST-Elevation–Myocardial Infarction: Risk Stratification by Visualization of Wall Motion, Edema, and Delayed-Enhancement Cardiac Magnetic Resonance**

**Summary:** Cardiac magnetic resonance (CMR) is a useful tool to evaluate left ventricular myocardial damage after reperfused ST-elevation–myocardial infarction. It provides detailed prognostic information by visualizing edema, infarct size, and microvascular obstruction. Recently, CMR has also been introduced for detection of right ventricular injury (RVI); however, the prognostic significance of such findings has not yet been established. RVI is typically detected by echocardiography and/or ECG, but wall motion impairment of the inferior RV wall is difficult to visualize in echocardiography, and ECG changes of RVI may be transient. This work demonstrates the value of CMR for not only diagnosis, but also prognosis in demonstrating and quantifying RVI after ST-elevation–myocardial infarction. Similar to the left ventricle, myocardial salvage index can be calculated for the RV.

**Conclusions:** RVI detected by cardiac magnetic resonance is a strong and independent predictor of clinical outcome after acute reperfused STEMI.

**Sex Differences in Myocardial Salvage and Clinical Outcome in Patients With Acute Reperfused ST-Elevation–Myocardial Infarction: Advances in Cardiovascular Imaging**

**Summary:** Studies have highlighted important sex differences in the pathophysiology, presentation, treatment, and outcome of ischemic heart disease. It has been also speculated that the efficacy (myocardial salvage) of primary percutaneous coronary intervention (PCI) in high-risk patients with ST-elevation–myocardial infarction (STEMI) seems to be sex-dependent. Whether sex disparities in clinical care and death after STEMI are still present in the current PCI era remains a matter of constant debate and has important clinical implications. In this study, the authors analyzed the relationship between sex and outcomes as well as sex and myocardial salvage in an unselected and consecutive population of patients with STEMI exclusively reperfused by primary PCI. Their study is the first using cardiac MRI for assessment of sex-specific reperfusion therapy efficacy. The authors observed no sex-associated differences in myocardial salvage and reperfusion injury. Although women STEMI patients had higher unadjusted in-hospital and 30-day mortality rates than did men, multivariate analysis revealed that these differences were likely because of disparities in baseline risk. Thus, the authors’ data highlight that sex by itself, in the current PCI era, does not independently predict death after STEMI and that once women are referred for cardiac catheterization, revascularization practices, success, and complications are similar to those in men.

**Conclusions:** The efficacy of primary percutaneous coronary intervention (myocardial salvage) in patients with STEMI is not sex dependent. Although women STEMI patients had worse unadjusted in-hospital and 30-day clinical outcomes than did men, multivariate analysis revealed that the observed sex-based differences in early death after STEMI were likely related to differences in baseline risk and clinical characteristics.

**Dynamic Changes of Edema and Late Gadolinium Enhancement After Acute Myocardial Infarction and Their Relationship to Functional Recovery and Salvage Index**

**Summary:** Late gadolinium enhancement (LGE) and edema imaging are used to assess acute myocardial injury, area at risk, and salvaged
myocardium after reperfusion. LGE is currently considered the gold standard for myocardial infarct visualization both in acute and chronic myocardial infarction and an accurate predictor of recovery of wall motion after revascularization. The present study shows that cardiac magnetic resonance features of acute myocardial infarction are dynamic and change for both LGE and edema. After revascularization, edema is shown to peak within the first week after reperfusion. LGE performed in the first 24 hours does not necessarily indicate irreversible injury; the authors’ results show that 51% of the segments with transmural LGE at 24 hours after reperfusion recovered function at 6 months. A detailed knowledge of the early dynamic changes of both LGE and edema imaging is crucial in assessing final infarct size and myocardium salvage, especially when designing clinical trials using cardiac magnetic resonance.

Conclusions: Myocardial edema is maximal and constant over the first week after myocardial infarction, providing a stable window for the retrospective evaluation of area at risk. By contrast, myocardial areas with high signal intensity in LGE images recede over time with corresponding recovery of function, indicating that acutely detected LGE does not necessarily equate with irreversible injury and may severely underestimate salvaged myocardium.9

**Characterizing Myocardial Edema and Hemorrhage Using Quantitative T2 and T2* Mapping at Multiple Time Intervals Post ST-Segment Elevation Myocardial Infarction**

**Summary:** Cardiovascular magnetic resonance imaging has gained clinical importance in the noninvasive assessment of myocardial injury parameters including myocardial edema, hemorrhage, microvascular obstruction, and infarct size post acute myocardial infarction. The authors prospectively characterized the evolution of these parameters post reperfused acute myocardial infarction at both early and late time points. The authors noted that edema is still present in infarcted tissue at 3 weeks, whereas hemorrhage resolves faster. Noninfarcted segments can demonstrate edema in the acute phase as well, perhaps indicative of more severe myocardial injury. The presence of hemorrhage in the acute phase makes edema quantification challenging due to susceptibility effects. In addition, both hemorrhage and microvascular obstruction are associated with worse left ventricular remodeling. Gaining this knowledge about the temporal resolution of myocardial damage and its impact on remodeling processes using quantitative techniques is potentially important in grading severity, evaluating treatment strategies, and improving clinical outcomes.

Conclusions: Quantification of myocardial edema and hemorrhage by T2 and T2* mapping is feasible post acute myocardial infarction and demonstrates that hemorrhage resolves faster than edema. Noninfarcted segments can also demonstrate edema in the acute phase possibly due to global hyperemia.9

**Quality of Care and Systems of Care**

**Care Processes Associated With Quicker Door-In–Door-Out Times for Patients With ST-Elevation–Myocardial Infarction Requiring Transfer: Results From a Statewide Regionalization Program**

**Summary:** Shortening transfer delays from hospitals without percutaneous coronary intervention (PCI) to hospitals with PCI capability remains a top priority to improve ST-segment elevation–myocardial infarction (STEMI) care and patient outcomes. There are few data identifying factors that contribute to shorter door-in-door-out times among STEMI patients evaluated at non-PCI hospitals.

Conclusions: Prehospital, ED, and hospital processes of care were independently associated with shorter door-in-door-out times for STEMI patients requiring transfer. Adoption of several EMS processes was associated with the largest reduction in treatment times. These findings highlight the need for an integrated, system-based approach to improving STEMI care.10

**Left Ventricular Ejection Fraction Assessment Among Patients With Acute Myocardial Infarction and Its Association With Hospital Quality of Care and Evidence-Based Therapy Use**

**Summary:** In patients with acute myocardial infarction, the appropriate medical regimen and subsequent management are dependent, in part, on residual left ventricular function. Therefore, assessment of left ventricular ejection fraction is a class I guideline recommendation for patients after an acute myocardial infarction. This analysis demonstrates overall high rates of left ventricular ejection fraction assessment in recent years; however, significant variability in assessment rate exists between hospitals. Importantly, hospitals with lower rates of left ventricular ejection fraction assessment are associated with lower quality of care for patients with acute myocardial infarction.

Conclusions: The assessment of LVEF among patients with AMI has improved significantly over time, yet significant interhospital variability exists. Patients who did not have in-hospital LVEF assessment were less likely to receive evidence-based medications at discharge. These patients represent targets for future quality improvement efforts.11

**Transfer Times and Outcomes in Patients With ST-Segment–Elevation Myocardial Infarction Undergoing Interhospital Transfer for Primary Percutaneous Coronary Intervention: APEX-AMI Insights**

**Summary:** Randomized trials have found that rapid transfer of patients with STEMI to PCI-capable centers improves outcomes compared with immediate fibrinolysis. Observational studies have shown that only a fraction of patients undergoing interhospital transfer for PCI in the United States meet guideline-recommended door-to-balloon times and that delays in portions of the transfer process (eg, D1D2 time in transfer hospital) are associated with increased mortality. This study used an integrated measure of interhospital transfer delay, D1D2 time, which incorporates both presenting hospital and transportation delays. Longer D1D2 times were associated with a higher incidence of death, shock, and heart failure at 90 days, although the association was no longer significant after multivariable adjustment. Lack of an independent association of the interhospital transfer delays observed within the Assessment of Pexelizumab in Acute Myocardial Infarction (APEX-AMI) trial may have been, at least in part, owing to the relatively short delays compared with other controlled trials and observational registries.

Conclusions: Longer transfer times were associated with higher rate of death, shock, and heart failure among patients undergoing interhospital transfer from primary percutaneous coronary intervention, although this difference did not persist after adjusting for baseline characteristics.12

**Mortality Implications of Primary Percutaneous Coronary Intervention Treatment Delays: Insights From the Assessment of Pexelizumab in Acute Myocardial Infarction Trial**

**Summary:** Primary percutaneous coronary intervention (PCI) reperfusion delays for patients with ST-elevation–myocardial infarction are associated with increased mortality. Prior studies differ on whether patient total ischemic time (symptom onset-to-balloon) or hospital “door-to-balloon” time more strongly predict mortality. Advanced age, female sex, and interhospital transfer are important determinants of primary PCI reperfusion delays. Mortality following...
ST-elevation–myocardial infarction rises sharply with symptom onset-to-balloon delays exceeding 5 hours and linearly with any door-to-balloon delay.

**Conclusions:** Both symptom onset-to-balloon time and hospital door-to-balloon time are strongly associated with 90-day mortality following STEMI.15

**Dimensions of Socioeconomic Status and Clinical Outcome After Primary Percutaneous Coronary Intervention**

**Summary:** There is a well-known association between low socioeconomic status (SES) and high incidence of and mortality from coronary heart disease. There also seems to be SES-related differences in care among ST-elevation–myocardial infarction patients, but the exact role of SES in relation to post-ST-elevation–myocardial infarction outcomes remains poorly understood.

**Conclusions:** Even in a tax-financed healthcare system, low-SES patients treated with primary percutaneous coronary intervention face a worse prognosis than high-SES patients. The poor outcome seems to be largely explained by differences in baseline patient characteristics. Employment status and income (but not education level) were associated with clinical outcomes.14

**Transport Time and Care Processes for Patients Transferred With ST-Segment–Elevation Myocardial Infarction: The Reperfusion in Acute Myocardial Infarction in Carolina Emergency Rooms Experience**

**Summary:** There are multiple components to the interhospital transfer process for ST-segment-elevation myocardial infarction patients that make the process challenging. Achieving timely reperfusion requires an integrated well-developed regional system of ST-segment-elevation myocardial infarction care. Interhospital transfer can be achieved via different modes, namely ground versus air transport. Significant challenges remain in achieving guideline-based reperfusion goals for ST-segment-elevation myocardial infarction patients initially presenting to more distant non-PCI hospitals. Air transport may not necessarily be associated with faster reperfusion times, perhaps as a result of lengthier door-in-door-out times at the transferring hospital.

**Conclusions:** In a well-developed ST-segment-elevation myocardial infarction system, D2D times within 90 to 120 minutes seem most feasible for hospitals within 30-minute transfer drive time. Helicopter transport did not offer D2D time advantages for transferred STEMI patients. This finding appears to be attributable to comparably longer door-in-door-out times for air transfers.15

**One-Year Clinical Outcome of Interventionalist- Versus Patient-Transfer Strategies for Primary Percutaneous Coronary Intervention in Patients With Acute ST-Segment Elevation Myocardial Infarction: Results From the REVERSE-STEMI Study**

**Summary:** Primary percutaneous coronary intervention (PPCI) is the preferred treatment option for patients with ST-segment elevation myocardial infarction (STEMI) presenting to PPCI-capable hospitals. Interhospital transfer often is used for patients with STEMI who present to hospitals without PPCI capability. This multicenter, prospective, randomized clinical study compares the 1-year outcomes of patients with STEMI treated by a strategy of interhospital patient transfer versus that of interventionalist transfer to regional hospital PPCI. The interventionalist-transfer strategy resulted in significantly shorter door-to-balloon times and better 1-year clinical outcomes. This novel strategy of interventionalist transfer for PPCI may improve the care of patients with STEMI presenting to a non-PPCI-capable hospital, particularly in regions where patient transfers are prolonged by delays in transport.

**Conclusions:** The interventionalist-transfer strategy for PPCI may be effective in improving the care of patients with STEMI presenting to a non-PPCI-capable hospital, particularly in a congested cosmopolitan region where patient transfers could be prolonged.16

**Why Does Primary Angioplasty Not Work in Registries? Quantifying the Susceptibility of Real-World Comparative Effectiveness Data to Allocation Bias**

**Summary:** There is conflict between randomized, controlled trials demonstrating that primary angioplasty is superior to fibrinolysis in ST-segment elevation myocardial infarction, and observational, registry-based comparative effectiveness research contradicting this. Understanding the basis of this conflict could help determine how future comparisons between therapies should be conducted. The conflict between randomized, controlled trials and observational research may be explained by preferential allocation of higher risk patients by clinicians to primary angioplasty. The authors derived a formula for resistance to allocation bias of observational results, the Number needed to Abolish, and demonstrate that it is small for myocardial infarction. The results of this study suggest that observational comparative efficacy research is especially vulnerable to incorrect conclusions when clinicians (a) can readily identify a high-risk subset, and (b) preferentially allocate them to one therapy rather than the other.

**Conclusions:** In ST-segment elevation myocardial infarction, clinicians’ preference for management of a few high-risk patients can shift mortality substantially. Comparative effectiveness research in any disease is vulnerable to this, especially diseases with an immediately identifiable high-risk subgroup that clinicians prefer to allocate to 1 therapy. For this reason, preliminary indications from registry-based comparative effectiveness research should be definitively tested by randomized, controlled trials.17

**Impact of Door-to-Activation Time on Door-to-Balloon Time in Primary Percutaneous Coronary Intervention for ST-Segment Elevation Myocardial Infarctions: A Report From the Activate-SF Registry**

**Summary:** Door-to-balloon time in primary percutaneous coronary intervention for ST-elevation–myocardial infarction is strongly related to both short- and long-term mortality. The time from hospital arrival to ST-segment elevation myocardial infarction diagnosis and activation of the catheterization laboratory (door-to-activation time) varies widely at the hospital level and is more strongly correlated with overall door-to-balloon times than other components of the primary percutaneous coronary intervention process.

**Conclusions:** Achieving a door-to-activation time ≤20 minutes was key to achieving a door-to-balloon time ≤90 minutes. Delays in door-to-activation time are not associated with delays in other aspects of the primary percutaneous coronary intervention process.18

**Guideline Adherence After ST-Segment Elevation Versus Non-ST Segment Elevation Myocardial Infarction**

**Summary:** Despite pathophysiologic differences between ST-segment elevation myocardial infarction and non–ST-segment myocardial infarction, the guidelines for medical treatment are nearly identical. Patients with latter are often afflicted by more numerous medical comorbidity, however, rates of guideline adherence are lower in these patients. The Get With the Guidelines–Coronary Artery Disease program aims to improve compliance with guideline-based therapy in these patients. Rates of guideline adherence are generally high, however, a small difference remains between those having ST segment elevation myocardial infarction and non-ST-segment myocardial infarction.
Conclusions: Among hospitals participating in GWTG–CAD, adherence with guideline-based medical therapy was high for patients with both STEMI and NSTEMI. Yet, there is still room for further improvement, particularly in the care of NSTEMI patients.39

Development of 2 Registry-Based Risk Models Suitable for Characterizing Hospital Performance on 30-Day All-Cause Mortality Rates Among Patients Undergoing Percutaneous Coronary Intervention

Summary: The outcomes of patients undergoing percutaneous coronary intervention vary by the quality of care provided. To date, the United States has not had a national effort to monitor or report percutaneous coronary intervention mortality rates, in part due to the absence of mechanisms for systematically collecting and analyzing the data needed to adjust for differences in case mix across institutions that perform percutaneous coronary intervention. Two models of 30-day percutaneous coronary intervention mortality that leverage the clinical information collected by percutaneous coronary intervention hospitals through the National Cardiovascular Data Registry’s CathPCI Registry. The models produce hospital specific estimates of risk-standardized 30-day mortality rates for patients undergoing percutaneous coronary intervention. These models are consistent with the consensus standards for publicly reported outcomes measures and have been approved by the National Quality Forum for this purpose.

Conclusions: These National Quality Forum endorsed registry-based models produce estimates of hospital risk-standardized mortality rates for patients undergoing PCI.20

Systems of Care for ST-Segment–Elevation Myocardial Infarction: A Report From the American Heart Association’s Mission: Lifeline

Summary: Coronary reperfusion can be greatly accelerated by coordinated care between hospitals and emergency medical services in a region. In a large national survey, several processes were commonly implemented, including accepting patients at a PCI hospital regardless of bed availability, single phone call activation of catheterization laboratory, emergency department physician activation of a laboratory without cardiology consultation, national data registry participation, and prehospital activation of the catheterization laboratory by paramedics and transferring physicians. The most commonly reported barriers to system implementation were hospital and cardiology group competition and EMS transport and finances.

Conclusions: This survey broadly describes the organizational characteristics of collaborative efforts by hospitals and emergency medical services to provide timely reperfusion in the United States. These findings serve as a benchmark for existing systems and should help guide healthcare teams in the process of organizing care for patients with STEMI.21

Comparative Effectiveness of Population Interventions to Improve Access to Reperfusion for ST-Segment–Elevation Myocardial Infarction in Australia

Summary: Many strategies are advocated to improve access to reperfusion therapy for STEMI. The population impacts of these interventions are unknown. The authors evaluated time access to reperfusion therapy for the Australian population and found that, overall, 93.2% had timely access predominately through fibrinolysis (53.0%) rather than PCI (42.0%). The authors found that the population interventions varied widely in their ability to improve timely access to reperfusion. Interhospital transfer and EMS diversion to PCI facilities increased timely access to reperfusion the most. Their analysis suggests significant potential to improve timely access to reperfusion by systematic deployment of interventions. Geographical Information Systems provides a robust tool to model the population effects of health service interventions.

Conclusions: Significant gaps in timely provision of reperfusion remain in Australia. Systematic implementation of changes in service delivery has potential to improve timely access to PCI for a majority of the population and improve access to fibrinolysis to those living in regional and remote areas.22

Expansion of a Regional ST-Segment–Elevation Myocardial Infarction System to an Entire State

Summary: Many of the decisions and processes that affect the speed of coronary artery reperfusion occur long before patients reach the cardiologist. Particularly in the case of patients who are diagnosed with ST-segment–elevation myocardial infarction (STEMI) on scene by paramedics, early catheterization laboratory activation can lead to reperfusion times <1 hour. Similarly, patients presenting to hospitals without primary percutaneous coronary intervention capability require coordinated protocols for diagnosis and transfer to be treated in <2 hours. In both scenarios, accelerated coronary reperfusion has been associated with improved survival. This article describes the largest voluntary statewide system for ST-segment–elevation myocardial infarction diagnosis and treatment. The North Carolina Regional Approach to Cardiovascular Emergencies (RACE) system included every percutaneous coronary intervention hospital (n=21), most hospitals lacking percutaneous coronary intervention capability (n=98), and >500 emergency medical service agencies in a state of 9 million people. During a 2-year period, the implementation of common protocols resulted in significantly improved treatment times for patients presenting directly to percutaneous coronary intervention hospitals and patients requiring hospital transfer. Similar to prior work, treatment within guideline goals was associated with significantly lower mortality compared with those exceeding guideline goals (2.2% versus 5.7%; P<0.001).

Conclusions: Through extension of regional coordination to an entire state, rapid diagnosis and treatment of ST-segment–elevation myocardial infarction has become an established standard of care independently of healthcare setting or geographic location.21

Rates of Cardiac Catheterization Cancelation for ST-Segment Elevation Myocardial Infarction After Activation by Emergency Medical Services or Emergency Physicians: Results From the North Carolina Catheterization Laboratory Activation Registry

Summary: Regional ST-segment elevation myocardial infarction (STEMI) systems of care continue to develop and evolve, and now many metropolitan areas and states are organizing their efforts to provide timely reperfusion and intervention for an increasing number of patients. These systems now incorporate emergency medical services agencies and emergency departments as key drivers of their programs. It is important to acknowledge that activation of STEMI systems of care will inherently result in some degree of overtriage or false-positive activations if attempts are made to maximize the sensitivity in identifying all STEMI cases. In this statewide registry, including 14 percutaneous coronary intervention–capable hospitals receiving STEMI patients from their emergency medical services providers and referral hospitals, >3000 patients were followed to determine whether STEMI system activation was deemed to be appropriate or inappropriate, and the ultimate manner of treatment was recorded. The odds of having an appropriate system activation varied by means of hospital presentation and institution type where the activation occurred, with the greatest odds of having an appropriate STEMI system activation occurring at percutaneous coronary intervention–capable hospitals. By better understanding these issues,
particular system components such as ECG interpretation and cathe-
terization laboratory candidacy issues can be identified and can serve
as a focus of continued process improvement and education.

Conclusions: This represents the first report of the rates of CCL can-
cellation for ST-segment elevation myocardial infarction system acti-
vation by emergency medical technicians and emergency physicians
in a large group of hospitals organized within a statewide program.
The high rate of coronary intervention and relatively low rate of inap-
propriate activation suggest that systematic CCL activation by emer-
gency personnel on a broad scale is feasible and accurate, and these
rates set a benchmark for ST-segment elevation myocardial infarction
systems.24

Benefit of Transferring ST- Segment– Elevation
Myocardial Infarction Patients for Percutaneous
Coronary Intervention Compared With Administration
of Onsite Fibrinolytic Declines as Delays Increase

Summary: The 2 major reperfusion strategies for ST-segment–
elevation myocardial infarction are primary percutaneous coro-
nary intervention (PCI) and fibrinolytic therapy (FT). Because not
all hospitals perform primary on a full-time basis, patients with
ST-segment–elevation myocardial infarction presenting to hospitals
without primary PCI capability are often transferred for primary
PCI (X-PCI) and do not receive onsite fibrinolytic therapy (O-FT).
Although randomized trials support X-PCI compared with O-FT,
these trials inform the clinician only about the comparative efficacy
of the 2 strategies for the small group of ST-segment–elevation myo-
cardial infarction patients who can be transferred rapidly with short
treatment times. In the United States, the majority of patients who
are transferred for PCI do not receive it in a timely fashion. This analysis
evaluates the time-dependent loss of X-PCI benefit compared with
O-FT and finds that the survival benefit of X-PCI over O-FT is lost
after ≈120 minutes of PCI-related delay. Almost half of the patients
transferred for PCI exceeded this threshold. The clinician should con-
sider a patient’s risk for ischemic complications, bleeding, and stroke
and PCI-related delay when selecting X-PCI or O-FT for patients
with ST-segment–elevation myocardial infarction presenting to hos-
pitals without primary PCI capability.

Conclusions: PCI-related delays are extensive among patients trans-
ferred for X-PCI and are associated with poorer outcomes. No differ-
ential excess in mortality was seen with X-PCI compared with O-FT
even with long PCI-related delays, but as XDB door-to-needle time
times increase, the mortality advantage for X-PCI compared with
O-FT declines.25

Causes of Delay and Associated Mortality in Patients
Transferred With ST- Segment–Elevation Myocardial
Infarction

Summary: Regional ST-segment–elevation myocardial infarction sys-
tems are being developed to improve timely access to primary percu-
naneous coronary intervention (PCI). System delays may diminish
the mortality benefit achieved with primary PCI in ST-segment–elevation
myocardial infarction patients, but the specific reasons for and clini-
cal impact of delays in patients transferred for PCI are unknown. The
authors report the frequency, magnitude, and clinical impact of spe-
cific delays that occur at the referral hospital, during transport, and
at the PCI hospital for 2034 patients transferred for PCI in a regional
ST-segment–elevation myocardial infarction system. Despite the use
of evidence-based strategies to improve treatment times, delays still
occurred frequently within the ST-segment–elevation myocardial
infarction system. Delays occurred most frequently at the referral
hospital, and were most often due to awaiting transport and emer-
gency department delays. Delays occurred less frequently during
transport or at the PCI center. Diagnostic dilemmas and nondiag-
nostic initial ECGs led to delays of the greatest magnitude but had
limited or no impact on mortality. Delays caused by out-of-hospital
cardiac arrest and/or cardiogenic shock had the highest impact on
in-hospital mortality. In these high-risk patients, the delay rarely led
to the cardiac arrest or cardiogenic shock; instead, the critical nature
of the patient’s illness resulted in the delay. These results have impli-
cations for the design of regional ST-segment–elevation myocardial
infarction systems and may affect the current American College of
Cardiology/American Heart Association guidelines for time to treat-
ment in transferred patients.

Conclusions: Treatment delays occur even in efficient systems for
ST-segment–elevation myocardial infarction care. The clinical impact
of specific delays in interhospital transfer for PCI varies according to
the cause of the delay.26

Improvements in Door- to-Balloon Time in the United
States, 2005 to 2010

Summary: In the United States, many groups, including the federal
government, the American College of Cardiology, the American Heart
Association, healthcare professionals, hospitals, emergency medical
services, and the research community, have focused on improving
door-to-balloon times for patients with ST-segment-elevation myo-
cardial infarction who are referred for an emergency percutaneous
coronary intervention. The authors report the national experience in
door-to-balloon times based on the Centers for Medicare & Medicaid
Services’ measure, which includes all patients of all ages. The door-
to-balloon time declined from a median of 96 minutes in the year
ending December 31, 2005, to a median of 64 minutes in the 3 quar-
ters ending September 30, 2010. There were corresponding increases
in the percentage of patients who had times <90 minutes (44.2% to
91.4%) and <75 minutes (27.3% to 70.4%). This improvement,
experienced across the country and across different types of hospis-
tals, represents a remarkable elevation in practice that was achieved
during a relatively short period of time and in the absence of finan-
cial incentive. The improvement demonstrates the results that can be
produced by collaboration among healthcare professionals, hospitals,
and national organizations toward the achievement of a shared goal.

Conclusions: National progress has been achieved in the timeliness of
treatment of patients with ST-segment–elevation myocardial infarc-
tion who undergo primary percutaneous coronary intervention.27

Use of Emergency Medical Service Transport Among
Patients With ST- Segment–Elevation Myocardial
Infarction: Findings From the National Cardiovascular
Data Registry Acute Coronary Treatment Intervention
Outcomes Network Registry–Get With the Guidelines

Summary: Although current guidelines recommend activation
of emergency medical services (EMS) for the expedited triage of
patients experiencing cardiac chest pain, EMS has historically been
underused. In this article, the authors explored the prevalence of
EMS use among contemporary patients with ST-segment–elevation
myocardial infarction, the sociodemographic and clinical factors
associated with a patient’s decision regarding mode of transport, and
the differences in treatment between those patients who self-trans-
port and those who use EMS. Examining the ST-segment–elevation
myocardial infarction patients in the National Cardiovascular Data
Registry Acute Coronary Treatment and Intervention Outcomes
Network Registry–Get With the Guidelines, the authors found that
EMS remains underused, with only 60% of patients arriving to an
emergency room via EMS. Patients who do not use EMS are more
likely male, Hispanic, and younger than EMS users. The decision
to use EMS was associated with at least a 30-minute reduction in
symptom onset to arrival time, which is a substantial shortening of
the total ischemic time. The decision to use EMS was also associated
with reduced delays to in-hospital evaluation and reperfusion treat-
ment. The authors think their findings indicate a pressing need for
community education efforts targeted at known demographic groups who underuse EMS transport. Furthermore, these efforts need to be integrated with system-wide strategies to improve reperfusion care.

**Conclusions:** Emergency medical services transportation to the hospital is underused among contemporary ST-segment–elevation myocardial infarction patients. Nevertheless, use of EMS transportation is associated with substantial reductions in ischemic time and treatment delays. Community education efforts are needed to improve the use of emergency transport as part of system-wide strategies to improve ST-segment–elevation myocardial infarction reperfusion care.28

**Reperfusion**

**Long-Term Follow-Up of Early Versus Delayed Invasive Approach After Fibrinolysis in Acute Myocardial Infarction**

**Summary:** Optimal reperfusion strategy in ST-elevation–myocardial infarction is controversial. Failure of fibrinolytic therapy is related to limited efficacy, high recollusion rates, reinfarction, and systemic bleeding complications. Data on the impact of percutaneous coronary revascularization (PCI) after fibrinolysis are conflicting. The Southwest German Interventional Study in Acute Myocardial Infarction (SIAM III) evaluated the effects of transfer for early PCI in acute ST-elevation–myocardial infarction compared with a conservative delayed PCI treatment strategy in patients receiving fibrinolysis <12 hours after onset of symptoms. During a mean follow-up time of 7.9±3.4 years (maximum, 11.2 years), early PCI was associated with a significant reduction of the primary end point consisting of death, reinfarction, target lesion revascularization, and ischemic events. Early PCI after fibrinolysis improves long-term event-free survival compared with a conservative delayed PCI treatment strategy. Therefore, patients undergoing fibrinolysis in ST-elevation–myocardial infarction should be transferred for early PCI.

**Conclusions:** Early PCI after fibrinolysis improves long-term event-free survival compared with a delayed PCI treatment strategy.29

**Primary Percutaneous Coronary Intervention as a National Reperfusion Strategy in Patients With ST-Segment Elevation Myocardial Infarction**

**Summary:** Primary percutaneous coronary intervention (PPCI) is recommended as the preferred reperfusion strategy in patients with ST-segment elevation myocardial infarction if initiated in a timely manner. Successful implementation of PPCI is the only reperfusion strategy used in Denmark. When combining prehospital diagnosis with field triage, the majority of patients with ST-segment elevation myocardial infarction are admitted directly to the invasive center for PPCI.

**Conclusions:** A reperfusion strategy with PPCI only for patients with ST-segment elevation myocardial infarction was successfully implemented in Western Denmark, and the majority of patients transported by the EMS are now triaged directly to the PPCI centers. This strategy is associated with lower mortality.30

**Use and Effectiveness of Intra-Aortic Balloon Pumps Among Patients Undergoing High Risk Percutaneous Coronary Intervention: Insights From the National Cardiovascular Data Registry**

**Summary:** Intra-aortic balloon pumps can be used to provide hemodynamic support to patients undergoing high-risk PCI. Studies evaluating the effectiveness of IABPs for this purpose have shown conflicting results. The proportion of high-risk PCI patients who have an IABP placed varies widely across hospitals (median 9.3%, interquartile range 6.5–14.2%; range 0–40%). The outcomes of patients treated at hospitals that used IABP less frequently were comparable with those of patients treated at hospitals that used IABP more frequently. These findings should prompt hospitals performing high-risk PCI to closely examine their practice regarding the use of IABP given the absence of data clearly identifying a benefit from IABP use.

**Conclusions:** IABP use varied significantly across hospitals for high risk PCI. However, this variation in IABP use was not associated with differences in in-hospital mortality.31

**Pharmacotherapy**

**Bivalirudin Therapy Is Associated With Improved Clinical and Economic Outcomes in ST-Elevation–Myocardial Infarction Patients Undergoing Percutaneous coronary Intervention: Results From an Observational Database**

**Summary:** In a randomized trial, bivalirudin compared with heparin+glycoprotein IIb/IIIa inhibition is associated with reduced bleeding complications and improved survival during STEMI treated with primary PCI. In a registry population of patients undergoing both elective and urgent PCI, bivalirudin was associated with improved outcomes. Clinical and economic outcomes among STEMI patients outside of clinical trials treated with bivalirudin are unknown. Bleeding complications are reduced with bivalirudin compared with heparin+glycoprotein IIb/IIIa inhibition in a registry population of STEMI patients treated with PCI. Economic outcomes are improved among STEMI patients treated with PCI and bivalirudin.

**Conclusions:** This large “real-world” retrospective analysis demonstrates that bivalirudin therapy compared with heparin+GPI is associated with a lower rate of inpatient death, inpatient bleeding, and decreased overall in-hospital cost in STEMI patients undergoing PCI.32

**Effect of Iron Chelation on Myocardial Infarct Size and Oxidative Stress in ST-Elevation–Myocardial Infarction**

**Summary:** The pathophysiology of ischemia-reperfusion injury is complex and multifactorial and includes the production of reactive oxygen species (ROS) on reperfusion and the continued postinfarct inflammatory response. Redox-active iron released from macrophages and myocyte intracellular stores is capable of catalyzing ROS production via Fenton chemistry to generate potent oxidants that participate in lipid peroxidation and cellular injury. This study tested the hypothesis that decreasing the production of ROS by iron chelation with deferoxamine might reduce ischemia-reperfusion injury and decrease myocardial infarct size. In a randomized, placebo-controlled trial, iron chelation with deferoxamine after the onset of ischemia and continued periprocedurally in primary percutaneous coronary intervention for STEMI reduced serum iron concentrations and ameliorated oxidative stress but did not limit infarct size compared with placebo. Numerous classes of pharmacological agents, including deferoxamine, although showing promise in experimental models of myocardial infarction, have not translated positively in clinical trials.

**Conclusions:** Adjunctive DFO treatment after the onset of ischemia and continued periprocedurally ameliorates oxidative stress without limiting infarct size.33

**Clinical Events as a Function of Proton Pump Inhibitor Use, Clopidogrel Use, and Cytochrome P450 2C19 Genotype in a Large Nationwide Cohort of Acute Myocardial Infarction: Results From the French Registry of Acute ST-Elevation and Non–ST-Elevation–Myocardial Infarction (FAST-MI) Registry**

**Summary:** Over the past months, there has been an intense scientific debate on the potential clinical impact of proton pump inhibitor use in patients treated with clopidogrel. There is a potential for drug-drug interactions due to the inhibition of CYP2C19, the primary enzyme responsible for metabolism of clopidogrel, leading to increased absorption and bioavailability of the drug. This increased exposure to clopidogrel may contribute to a higher risk of clinical events such as reinfarction, stent thrombosis, and bleeding complications. However, the clinical significance of these interactions is controversial, and more research is needed to fully understand their impact on patient outcomes.

**Conclusions:** Further studies are needed to elucidate the clinical significance of the interactions between proton pump inhibitors and clopidogrel in the setting of acute myocardial infarction, particularly in relation to bleeding complications and the risk of clinical events. Continued clinical trials and observational studies are essential to guide appropriate management strategies for patients receiving these medications.
interactions because many proton pump inhibitors are metabolized by or are inhibitors of the cytochrome P450 2C19 (CYP2C19) enzyme. The stakes are considerable, given the huge number of patients treated with these medications. Specifically, the impact of CYP2C19 genetic polymorphisms on clinical outcomes in patients receiving a proton pump inhibitor and clopidogrel has not been evaluated. Overall, proton pump inhibitor use was not associated with an increased risk for any of the main outcomes (in-hospital and 1-year survival, 1-year myocardial infarction– and stroke-free survival, 1-year major ischemic events in hospital survival, in-hospital bleeding and transfusion) in either the overall population or any of the subgroups tested. One of the key new findings of the present analysis is that there was no clinically relevant association in adverse cardiovascular events or mortality among patients with no or 1 CYP2C19 loss-of-function allele. Thus, in this population, the results do not support the avoidance of proton pump inhibitor use for those patients receiving clopidogrel who are at increased risk of gastrointestinal bleeding. However, because of the low number of patients and resultant large confidence interval ranges, the possibility that a higher early risk may exist in patients with 2 CYP2C19 variant alleles cannot be dismissed and needs further clinical studies. The authors think that these results are important for physicians in charge of these patients.

Conclusions: PPI use was not associated with an increased risk of cardiovascular events or mortality in patients administered clopidogrel for recent MI, whatever the CYP2C19 genotype, although harm could not be formally excluded in patients with 2 loss-of-function alleles.34

Exenatide Reduces Final Infarct Size in Patients With ST-Segment–Elevation Myocardial Infarction and Short-Duration of Ischemia

Summary: Reperfusion injury after vessel recanalization is a determinant of infarct size in patients with STEMI. Ischemic postconditioning, cyclosporine, remote ischemic preconditioning, and cooling have been shown to be cardioprotective and limit reperfusion injury. Exenatide, a GLP-1 analog, decreased infarct size in experimental models of reperfusion injury. Exenatide increased myocardial salvage index in patients with STEMI undergoing primary PCI. Treatment with exenatide before the onset of reperfusion with primary PCI decreased final infarct size by 30% in STEMI patients with TIMI flow 0/1 and a short duration of ischemia (≤132 minutes). Treatment with exenatide in STEMI patients with TIMI flow 0/1 and a long duration of ischemia (>132 minutes) was not found to be cardioprotective. The beneficial cardioprotective effects of exenatide are achieved only when the duration of ischemia before primary PCI is short (≤132 minutes). When given after this time, exenatide did not decrease infarct size significantly.

Conclusions: In this post hoc analysis, exenatide treatment was associated with a 30% decrease in final infarct size in patients with short system delay, whereas no cardioprotective effect in patients with long system delay was seen. However, this finding must be confirmed in larger studies.35

Prehospital Abciximab in ST-Segment Elevation Myocardial Infarction: Results of the Randomized, Double-Blind MISTRAL Study

Summary: Optimal timing of administration of glycoprotein IIb/IIIa inhibitors in patients with ST-segment elevation myocardial infarction treated by percutaneous coronary intervention is controversial. The FINESSE (Facilitated Intervention with Enhanced Reperfusion Speed to Stop Events) study investigators recorded no benefit of early versus late abciximab administration, but administration was late. However, the ON-TIME-2 (Ongoing Tirofiban in Myocardial Infarction Evaluation 2) study investigators showed that prehospital tirofiban (door-to-balloon time, 76 minutes) in patients with ST-segment elevation myocardial infarction improved ST-segment elevation resolution and Thrombolysis In Myocardial Infarction flow.

Conclusions: Early ambulance administration of abciximab in STEMI did not improve either STR or TIMI flow rate after PCI. However, it tended to improve TIMI flow pre-PCI and decreased distal embolization during procedure. Larger studies are needed to confirm these results.36

Use of Early Clopidogrel by Reperfusion Strategy Among Patients Presenting With ST-Segment Elevation Myocardial Infarction

Summary: Recent clinical trials have shown that the addition of early clopidogrel to aspirin in STEMI patients treated with fibrinolysis and in patients not treated with reperfusion therapy provides incremental benefit. The ACC/AHA STEMI guidelines were updated in 2007 to give a class I indication for clopidogrel administration in addition to aspirin in all STEMI patients regardless of whether they undergo reperfusion therapy (primary PCI or fibrinolysis). The authors describe current uptake of guideline recommendations on use of clopidogrel and trends in its use among STEMI patients according to reperfusion strategy. The authors also investigate the use of loading dose overall and by age and the association between clopidogrel use in in-hospital outcomes by reperfusion strategy and age group. Use of early clopidogrel in STEMI patients selected for fibrinolysis or no reperfusion is low despite guideline recommendations. In addition, despite a lack of efficacy and safety data in elderly patients, a loading dose of clopidogrel is used in more than two thirds of elderly patients receiving fibrinolysis or no reperfusion, which may increase the risk of bleeding. These results demonstrate the challenges associated with the translation of evidence from clinical trials into routine practice and suggest that efforts in performance improvement around early clopidogrel use are needed.

Conclusions: Early clopidogrel use has not yet extended to the routine care of STEMI patients treated with fibrinolysis or those not receiving reperfusion as recommended in the guideline update.37

Complications

Effects of Hydration in Contrast-Induced Acute Kidney Injury After Primary Angioplasty: A Randomized, Controlled Trial

Summary: Contrast-induced acute kidney injury (CI-AKI) is a significant cause of iatrogenic renal dysfunction, contributing to morbidity, prolonged hospitalization, mortality, and increased costs of healthcare. The routine use of hydration protocol before contrast exposure is an established preventive measure, recommended in the guidelines against CI-AKI in all elective angiographic procedures involving administration of iodine contrast material. However, the efficacy of this preventive strategy has not yet been established for patients with ST-elevation–myocardial infarction who are at higher risk of this complication after primary percutaneous coronary intervention. This prospective, randomized study shows that also among patients with acute myocardial infarction treated with primary percutaneous coronary intervention, intravenous volume expansion is beneficial against CI-AKI development. In particular, the regimen of early hydration with sodium bicarbonate significantly reduces the rate of CI-AKI compared with a regimen of only late hydration with saline or no hydration treatment. Early infusion guarantees a larger quantity of fluids than postprocedural hydration, and the amount of fluids administered plays an important role in this setting: multivariate analysis identifies a total hydration volume of ≥960 mL as one of the independent predictors of CI-AKI. Their findings suggest that routine procedure for patients with ST-elevation–myocardial infarction candidates to primary percutaneous coronary intervention should include standard pharmacological treatment associated with early hydration.
protocol, dosed according to patient weight and baseline ejection fraction, and started in the emergency room whenever feasible.

**Conclusions:** Adequate intravenous volume expansion may prevent CI-AKI in patients undergoing primary PCI. A regimen of preprocedure and postprocedure hydration therapy with sodium bicarbonate appears to be more efficacious than postprocedure hydration only with isotonic saline.36

**Predictors of Bleeding and Time Dependence of Association of Bleeding With Mortality: Insights From the Trial to Assess Improvement in Therapeutic Outcomes by Optimizing Platelet Inhibition With Prasugrel—Thrombolysis in Myocardial Infarction 38 (TRITON-TIMI 38)**

**Summary:** Several recent studies have shown that intensified dual antiplatelet therapy can reduce the risk of major cardiovascular events in patients with acute coronary syndromes, but with an increase in bleeding. The balance between benefit (prevention of ischemic events) and risk (significant bleeding) is therefore a key consideration in choosing the intensity of antiplatelet therapy. This analysis of the Trial to Assess Improvement in Therapeutic Outcomes by Optimizing Platelet Inhibition With Prasugrel—Thrombolysis in Myocardial Infarction 38 (TRITON-TIMI 38), which compared prasugrel to standard-dose clopidogrel in patients with acute coronary syndromes undergoing a planned percutaneous coronary intervention, showed that the most common types of serious bleeding were gastrointestinal and vascular access site bleeding. Variables most strongly associated with risk of serious bleeding were female sex, use of a glycoprotein IIb/IIIa inhibitor, duration of intervention, age, assignment to prasugrel, ST-elevation–myocardial infarction, femoral access for angiography, creatinine clearance, hypercholesterolemia, and hypertension. Serious bleeding was significantly associated with mortality after correction for these factors. Analyses focusing on the time dependency of this relationship showed that this association existed only for the first week after an instrumented or traumatic bleeding event.

**Conclusions:** The major predictors of serious bleeding were a combination of patient and procedural characteristics and antiplatelet therapies. Although serious bleeding was strongly associated with mortality within the first month of the bleeding event, this association was not significant beyond 40 days.39

**Association of Bleeding and In-Hospital Mortality in Black and White Patients With ST-Segment–Elevation Myocardial Infarction Receiving Reperfusion**

**Summary:** The authors evaluated data on blacks and whites with acute ST-segment–elevation myocardial infarction treated with either fibrinolysis or primary percutaneous coronary intervention from the National Registry of Myocardial Infarction (NRMI)-4 and -5 participating centers between July 2000 and December 2006 to determine race-related differences in bleeding and outcomes. The authors found that among patients with ST-segment–elevation myocardial infarction receiving fibrinolysis, the bleeding rates were higher for blacks (n=2283) than whites (n=42,243; 10.9% versus 10.3%; adjusted odds ratio, 1.21; 95% confidence interval, 1.02–1.43). Similarly, in patients receiving primary percutaneous coronary intervention, the bleeding rates were higher in blacks (n=2826) than whites (n=46,332; 10.3% versus 7.8%; adjusted odds ratio, 1.33; 95% confidence interval, 1.13–1.56). Bleeding was associated with a higher risk of death in both ethnic groups. However, there was no overall racial difference in in-hospital mortality among those with bleeding or without bleeding treated with either fibrinolysis or primary percutaneous coronary intervention. The authors concluded that race-related differences existed in bleeding risk among patients with ST-segment–elevation myocardial infarction receiving reperfusion therapy that portend poor prognosis. Thus, the efficacy and safety of many new drugs or treatment strategies for any disease observed in clinical trials that enroll predominantly white patients may not be similar in other ethnic groups that are underrepresented in these trials.

**Conclusions:** Blacks with ST-segment–elevation myocardial infarction treated with either fibrinolysis or primary percutaneous coronary intervention had a higher risk of bleeding events than their white counterparts. Bleeding was associated with a similar increased risk of death in both ethnic groups treated by either reperfusion strategy.40

**Prediction of Long-Term Mortality After Percutaneous Coronary Intervention in Older Adults: Results From the National Cardiovascular Data Registry**

**Summary:** Most survival prediction models for percutaneous coronary intervention are limited to in-hospital end points. Although short-term mortality rates remain low, multiple stakeholders, including providers, patients, and payers, will be more interested in long-term survival. The authors linked the broadly representative, real-world clinical data from the American College of Cardiology–National Cardiovascular Data Registry CathPCI Registry with vital statistics from the Medicare 100% denominator file to construct a robust, long-term percutaneous coronary intervention survival prediction model. This study included 343,466 patients aged 6263 years who underwent percutaneous coronary intervention either with or without ST-segment elevation myocardial infarction between 2004 and 2007. Median follow-up was 15 months, with mortality of 0.97% at 30 days, and 8.58%, 13.4%, and 18.3% at 1, 2, and 3 years, respectively.

Twelve-four demographic and clinical comorbidities, prior history of disease, and indices of disease severity and acuity were identified as being associated with mortality. Discrimination, calibration, and validation of the model were all excellent. The large sample size permitted precise estimates of the influence of clinical correlates on survival. Early mortality is predicted by variables related to acuteness of presentation, whereas longer-term mortality is associated with chronic debilitating diseases such as insulin-dependent diabetes mellitus and dialysis-dependent renal failure and behaviors such as cigarette smoking.

**Conclusions:** On the basis of the large and nationally representative CathPCI Registry, the authors have developed a model that has excellent discrimination, calibration, and validation to predict survival up to 3 years after percutaneous coronary intervention.41

**References**


Myocardial Infarction − ST-Elevation−Myocardial Infarction

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