Discontent is the first necessity of progress.

—Thomas Edison

In November of 1993, 3 reports that published simultaneously in the New England Journal of Medicine demonstrated the superiority of primary percutaneous coronary intervention (PCI) over thrombolytic therapy for treatment of patients with acute ST-segment–elevation myocardial infarction (STEMI).1–3 At that time, within my hospital system, the Johns Hopkins Health System, there were 2 acute care hospitals: the Johns Hopkins Hospital, a tertiary center with both PCI and cardiac surgery capability, and the Bayview Medical Center, a community hospital that could provide neither revascularization modality. In 1993, >20 patients with acute STEMI presented to our tertiary facility annually, whereas our community hospital admitted >5× that number. Because State healthcare regulation prohibited performance of PCI at hospitals without collocated cardiac surgery, the superior therapy could be applied at the hospital where the minority of patients presented, whereas at the hospital where the overwhelming majority of patients with STEMI presented primary PCI was not available.

This situation was replicated in many areas around the country, essentially restricting access to the better form of therapy for many patients with STEMI. The rationalized solution to this dilemma offered 2 alternatives: (1) continue to simply offer the “community hospital standard of care,” thrombolytic therapy, to patients with STEMI presenting to non-PCI hospitals or (2) transfer patients from non-PCI–capable to PCI-capable facilities for primary PCI. We were not satisfied with these proposed solutions. In the first, an inferior therapy is offered to patients with STEMI simply because of an accident of geography: they presented to the “wrong” hospital. Furthermore, transfer was not practical. According to Goggle Maps, in the absence of traffic, the Hopkins tertiary and community hospitals are separated geographically by 3.1 miles and temporally by 11 minutes. Yet in 1993, transfer could take ≥180 minutes because Emergency Medical Services (EMS) was not available for hospital-to-hospital transport on an emergency basis. Parenthetically, selective triage (transport of patients with STEMI directly to a PCI-capable hospital) was prohibited by regulations requiring EMS to transport to the nearest hospital.

Discontent with these alternatives led to The Cardiovascular Patient Outcomes Research Team primary PCI study,4 a randomized trial comparing the outcomes of primary PCI and thrombolytic therapy performed at hospitals without onsite cardiac surgery. Similar to other studies conducted at tertiary hospitals, the Cardiovascular Patient Outcomes Research Team primary PCI study demonstrated the superiority of primary PCI over thrombolytic therapy for patients with STEMI treated at hospitals without collocated cardiac surgery.5 This study and others led to the expansion of primary PCI capability to hospitals without onsite cardiac surgery, increasing access and decreasing the time to application of this superior reperfusion therapy. For a variety of reasons, expansion of primary PCI is neither feasible nor desirable at all hospitals that receive patients with STEMI. This is particularly true in smaller, rural facilities. The clear superiority of primary PCI as therapy for acute STEMI and the fact that its benefit is optimal when applied promptly has led to the development of several approaches other than expanding the number of PCI-capable hospitals aimed at maximizing the number of patients with STEMI who receive primary PCI and minimizing time to its application. Thus, Mission-Lifeline and other programs emphasize creation of regional systems of STEMI care that involves care coordination among patients, referring and PCI-capable hospitals, providers and medical transport systems.6–7

How well have these strategies worked? One’s assessment of a set of facts importantly depends on the lens through which those facts are viewed. In this issue of Circulation: Cardiovascular Interventions, Nicholson et al8 describe a system of interhospital transport of patients with STEMI still wanting, with median door-in-door-out (DIDO) times of 52 minutes and achievement of first-door-to-balloon times in excess of 120 minutes in half of patients with STEMI. Yet compared with the situation 2 decades ago, this report demonstrates remarkable success in reducing interhospital transport times and time to reperfusion. The median distance between referral and receiving hospitals is not 3.1 miles, but 31.9 miles, and the temporal “distance” 39, not 11, minutes. Yet transport and first-door-to-balloon times are far better than our interhospital transfer results 2 decades ago.

The authors are right, however, in not being content with the current situation because, like in 1993, patients who present to the “wrong hospital” do not receive optimal treatment according to current guidelines.

In dissecting the causes of prolonged time to reperfusion among patients requiring transport from a referral to a PCI-capable hospital, it is clear that the receiving hospitals are “ready” for the patient, with median door-to-PCI times <30 minutes. Most of treatment delay is related to getting the patient out of the referral hospital and into a transport, the DIDO time. The components of this time include identification of STEMI,
decision on the treatment, agreement by the patient for recommended treatment and transport, acceptance of the patient at the receiving hospital, and then actual transport. The authors properly identify this DIDO time as an important focus of improving reperfusion time in patients requiring transport to a PCI-capable facility. There is likely no one-size-fits-all logistical plan that applies to all referral hospitals, but the goals of that plan are similar: rapid ECG acquisition, preferably in the field, rapid ECG interpretation, an algorithm for decision-making and obtaining consent from the patient for treatment and transfer, prearranged algorithm for rapid determination of transport mode and its availability, reading the patient for transport (eg, changing intravenous tubing and pumps if required for a particular mode of transport), and prearranged receiving hospital alert mechanism. Prearrangement and practiced algorithms are keys to reducing the DIDO time. Monitoring and modification of the process outcomes of such a system is required over time.

Another method to reduce the DIDO time is to eliminate it completely with selective triage, bypassing hospitals without primary PCI capability. Selective triage is relatively easy in an urban and suburban environment where field to PCI-capable hospital transport is relatively short geographically and temporally. In fact, in some States, such as Maryland, selective triage of patients with STEMI diagnosed in the field is part of the EMS protocol. In a more rural setting, this may also be possible, as Nicholson et al suggest, but may be somewhat more difficult to effect. Selective triage could be associated with adverse outcomes if patients who might otherwise be stabilized promptly in the closest hospital are instead transported 230 minutes to a PCI-capable hospital for a procedure for which they may or may not actually be a candidate, depending on the whether the correct in-field diagnosis is made. Selective triage at distances averaging 31.9 miles and transport times averaging 39 minutes seems to require accurate EMS-diagnosis, assessment of clinical stability and patient understanding and acceptance of relatively long transport. In addition, a significant number of patients with STEMI do not use EMS and arrive at the receiving hospital by car. Although appealing conceptually, there may be limits to selective triage, and a robust and efficient transport algorithm for patients with STEMI remains a necessity.

Developing and sustaining regionalized systems of care is costly both in terms of human and financial resources. Nicholson et al are right to be dissatisfied with the current relationship between distance and delay, and, by identifying where delay is greatest, point the way toward improving the system of care for patients with STEMI who present to hospitals that cannot provide primary PCI.

During the past 2 decades, the thoughtful and diligent effort of literally thousands of professionals contributed to a remarkable improvement in providing prompt reperfusion to the greatest number of patients with STEMI by expanding the number of hospitals providing primary PCI, improving the logistics of care and, as documented in the current report, improving the transport of patients to those facilities. Pioneers like Raymond Bahr who conceived of the chest pain center, more recent work of national organizations like the American Heart Association and Mission-LifeLine, healthcare regulators, researchers, practicing physicians, paramedics, nurses and technical staff, and hospital administrators all made important contributions.

These improvements come at a substantial cost. The current system of primary PCI requires 24/7/365 physician, nursing, and technical staff. The extension of PCI capability to more hospitals stresses human and financial resources. Although not often considered, in developing countries where the incidence of coronary artery disease is rising, primary PCI is not practical because of an insufficient number of providers, insufficient infrastructure, and the prohibitive cost their development. Therefore, although expanding the number of PCI-capable hospitals and improving the system of care and its logistical components to provide access to the best care for the greatest number of patients with STEMI is an important and worthy effort, development a noninvasive, universally applicable, and reliable reperfusion therapy is the ultimate goal. We should remain discontent with STEMI care until then.

Disclosures

None.

References


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Distance, Delay, and Discontent
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