Another observation was that time to treatment was shorter. An explanation for these relationships is not readily apparent. Presence of these factors prolonged time to treatment. Female gender, and history of diabetes or prior revascularization was influenced by several factors, including advanced age, initial balloon inflation.

One key finding of their analysis was that time to treatment and outcome, the very best results were obtained when thrombolysis was initiated within the first hour. To this point, such a tight relationship between time to treatment and outcome has been less apparent when primary angioplasty is selected as the method for achieving reperfusion. Reports on this subject describe conflicting findings. With these considerations in mind, De Luca and colleagues performed a single-center database analysis and reported their results in the March 16, 2004, issue of Circulation. They reviewed the baseline and angiographic characteristics and clinical outcomes of 1791 patients with STEMI who were treated by primary angioplasty. Time to treatment was defined as the elapsed time between symptom onset and the initial balloon inflation.

One key finding of their analysis was that time to treatment was influenced by several factors, including advanced age, female gender, and history of diabetes or prior revascularization. Presence of these factors prolonged time to treatment. An explanation for these relationships is not readily apparent. Another observation was that time to treatment was shorter among patients in whom primary angioplasty achieved successful, complete reperfusion than among those for whom treatment was not successful. This finding suggests that PCI is more likely to be successful when performed in the earlier hours of STEMI. Perhaps most importantly, a continuous mathematical relationship was identified between time to treatment and outcome. Longer time to treatment was associated with a greater likelihood of a predischarge left ventricular ejection fraction <0.30 and death at 1 year. Specifically, for every 30-minute delay in treatment, the risk of experiencing major left ventricular dysfunction at discharge was increased by 8.7% and risk of death at 1 year by 7.5%. In concluding, the authors emphasized the importance of shortening the time to treatment when performing primary angioplasty for patients with STEMI.

Certain points should be noted before addressing the implications of this report. First, De Luca et al° measured time to treatment beginning with the time of symptom onset. This approach differs from many prior investigations that have focused on elapsed time from hospital arrival to time of therapy. This latter time period is one that can be influenced readily by changes in hospital practice patterns. A concern with using time of symptom onset as a metric relates to the ability to determine with accuracy and consistency when infarct symptoms really begin. Experienced clinicians are familiar with the erratic pattern of initial STEMI symptoms as well as marked differences in the quality or severity of these symptoms. Recognizing this concern, initial Thrombolysis in Myocardial Infarction (TIMI) trial investigators defined “symptom onset for STEMI” as the time when symptoms reached the point that a patient decided to seek medical attention. This approach, although arbitrary and perhaps imprecise in identifying the earliest infarct symptom, did ensure consistency. Unfortunately, in the report by De Luca et al.° symptom onset is not defined. Also, we are not provided with a description of the range of times to treatment or the component of time to treatment that occurred before hospital arrival or between door and balloon.

Another subject for discussion is the magnitude of the effect that was observed as a consequence of delay. For each 30 minutes of delay, there was an increase in risk for death of 7.5% and for ejection fraction <30% of 8.7%. It is important to note that these are increases in relative and not absolute rates of risk. For example, if a patient who was treated promptly had a 1-year risk of death of 7% after STEMI, a 30-minute delay would increase his risk to 7.5%. When evaluated on an individual patient basis, such increases in risk may not appear to be that meaningful. When considering that in excess of 400 000 deaths per year result from myocardial infarction, however, the impact of these risk rates is substantial. Also, the benefit for reducing the proportion of patients

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with severe left ventricular dysfunction would have profound
effects on quality of life, given the morbid consequences of
advanced heart failure and the expense associated with new
device-based therapies.

The principal implication of this investigation is to shorten
the delay in primary angioplasty treatment for STEMI. In
effecting such a change, it is appropriate to consider the
components that comprise the interval from symptom onset to
balloon inflation and their potential for contributing to delay
treatment. First, patients must become aware that they are
experiencing a STEMI and seek appropriate medical atten-
tion. The Rapid Early Action for Coronary Treatment
(REACT) study investigated this process and found that
patients were often unaware of the characteristics of infarct
symptoms, delayed requesting medical assistance, and rarely
called 9-1-1. Second, when patients suspected of having a
STEMI are transported by emergency medical services, they
are often taken to the nearest healthcare facility rather than to
the one that has primary angioplasty capability. Comparative
analyses indicate such an approach is associated with the
greatest magnitude of delay, averaging in excess of 3 hours,
when there is a need to transfer a patient from one hospital
lacking PCI capability to one that has this resource. Third,
establishing the diagnosis of STEMI after hospital arrival
often consumes more time than would be considered reason-
able. Fourth, a catheterization laboratory and staff and an
interventional cardiologist must be available to perform the
primary angioplasty procedure. During routine working
hours, a busy facility may not have a catheterization labora-
tory immediately available for an emergency. During off-
hours, considerable time may be required for support staff to
reach the hospital.

Optimally, a process aimed at minimizing time to treatment
from STEMI onset to the performance of primary angioplasty
should consider each of these components individually, as
well as their interrelationships. An example of such an effort
has recently been completed in Maryland under the guidance
of the Maryland Health Care Commission. Developed
through an advisory committee and Commission staff, a
series of recommendations are now being implemented in
that state. First, the Commission has recommended that the
Maryland Institute for Emergency Medical Services develop
and implement a protocol that will identify and triage STEMI
patients to a designated primary angioplasty center. This
approach is expected to include obtaining an ECG in the field,
confirming the diagnosis of STEMI, and transporting patients
not necessarily to the nearest hospital but rather to one with
primary angioplasty capability. It is important to note the
impact of the prehospital ECG on shortening time to treat-
ment. The prehospital ECG eliminates the time required to
establish the diagnosis of STEMI after hospital arrival and
also permits the catheterization laboratory to be informed that
a patient requiring primary angioplasty has been identified.
This early warning allows catheterization laboratory staff to
keep a catheterization laboratory available during routine
working hours or to travel to the hospital during off-hours.

A second recommendation was to establish criteria for a
primary angioplasty center. Such hospitals will need to
demonstrate that their STEMI patient volume and door-to-
balloon times meet established standards. The interventional
cardiologists who will perform primary angioplasty must
have appropriate training and experience. In this program,
presence of on-site coronary artery bypass surgery programs
is not a requirement for a hospital to become a primary
angioplasty center. Hospitals without such programs, how-
ever, will need to have a formal agreement with a tertiary
institution for immediate, supplemental patient care. Finally,
the entire program will be formally monitored to determine
compliance, safety, and effectiveness. A standardized dataset
will be developed, collected, and analyzed for each aspect of
the program. Continued participation will be based on accept-
able performance.

A second issue with regard to the importance of time to
treatment relates to the patient for whom, despite best effort,
circumstances delay time to treatment by primary angiop-
plasty. For many such patients, thrombolytic therapy remains
a legitimate option. In fact, within the early hours of STEMI,
recent studies suggest that there is no superiority of primary
PCI over thrombolytic therapy in terms of mortality rate. Forthcoming American Heart Association/American College
of Cardiology guidelines for treatment of STEMI will support
this concept that circumstances do exist in which thrombolytic therapy is preferred as the initial reperfusion
strategy. Furthermore, some have advocated the routine
administration of full- or partial-dose thrombolytic therapy
before performing primary angioplasty, particularly if a delay
may be anticipated. Thrombolytic therapy in this setting
would be considered as adjunctive therapy, facilitating reper-
fusion before definitive relief of coronary obstruction. To this
point, such an approach has not been validated, although
several clinical trials designed to evaluate this approach
currently are being conducted.

The report by De Luca et al provides additional informa-
tion that emphasizes the importance of reducing the elapsed
time from infarct onset to reperfusion therapy. Although this
relationship has been noted previously, a mandate to enhance
the expediency of STEMI management across healthcare
systems in the United States has not been forthcoming. On the
other hand, the feasibility of such programs has been well
demonstrated in other countries. More convincing evidence is
not required to make the point. Coordinated efforts among
community services, hospitals, and physicians will be neces-
sary to achieve the goal of shortening time to treatment.

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References
of ischemic cell death, I: Myocardial infarct size vs. duration of coronary
of acute myocardial infarction: reappraisal of the golden hour. Lancet.
thrombolysis for acute myocardial infarction: a meta-analysis. JAMA.

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Treatment Delayed Is Treatment Denied
David O. Williams

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