Circulation

AHA POLICY STATEMENT

Systems of Care for ST-Segment–Elevation Myocardial Infarction

A Policy Statement From the American Heart Association

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ABSTRACT: The introduction of Mission: Lifeline significantly increased timely access to percutaneous coronary intervention for patients with ST-segment–elevation myocardial infarction (STEMI). In the years since, morbidity and mortality rates have declined, and research has led to significant developments that have broadened our concept of the STEMI system of care. However, significant barriers and opportunities remain. From community education to 9-1-1 activation and emergency medical services triage and from emergency department and interfacility transfer protocols to postacute care, each critical juncture presents unique challenges for the optimal care of patients with STEMI. This policy statement sets forth recommendations for how the ideal STEMI system of care should be designed and implemented to ensure that patients with STEMI receive the best evidence-based care at each stage in their illness.

Key Words: AHA Scientific Statements ■ cardiac systems of care ■ ST-segment–elevation myocardial infarction

In 2007, the American Heart Association (AHA) introduced Mission: Lifeline, a national initiative to coordinate and improve the quality of care delivered to patients with ST-segment–elevation myocardial infarction (STEMI) and to decrease related mortality and morbidity.[1] The initial focus of Mission: Lifeline was to increase the number of patients with STEMI with timely access to primary percutaneous coronary intervention (PCI).[2] Bringing emergency medical services (EMS), STEMI referring hospitals, and STEMI receiving centers together in the development of local and regional systems of care has led to improvement in treatment time and outcomes. Moreover, regional STEMI systems of care implementation has been expanded to include other time-sensitive cardiovascular emergencies such as stroke and out-of-hospital cardiac arrest (OHCA).[3–5] However, opportunities remain to further improve the coordination of care and to decrease time to definitive treatment. Although the focus of this policy statement is primarily on systems development and implementation for patients with STEMI, many of the system barriers identified and processes and solutions leading to improved and timely delivery of care can and should be applied to all time-sensitive cardiovascular disorders.

MISSION: LIFELINE: PROGRESS TO DATE

Since the launch of the Mission: Lifeline STEMI program, >85% of the US population is reported as being covered by a STEMI system of care with 857 hospitals included in 92 Mission: Lifeline regions.[6] Between 2008 and 2012, use of prehospital ECGs and time to treatment significantly improved in hospitals (n=485) and patients (n=147 466) participating in Mission: Lifeline[7] (Table 1). Between 2012 and 2019, the trends in STEMI systems of care listed in Table 2 have occurred.[6]

Although there have been significant improvements in patients with STEMI receiving guideline-recommended care, progress has slowed during the past few years. Opportunities remain to further improve the system of

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Table 1. Mission: Lifeline STEMI Systems of Care, 2008 to 2012

Variable	2008	2009	2010	2011	2012	*P* value*
Prehospital ECGs among EMS transport to PCI centers, %	45.3	57.7	61.1	65.9	71.3	<0.001
Door-to-device time (all direct presenters), min	68 (52, 86)	63 (48, 80)	61 (47, 78)	60 (44, 76)	59 (43, 75)	<0.001
FMC-to-device time (EMS+direct presenters at PCI centers), min	93 (77, 112)	90 (74, 108)	89 (72, 107)	86 (70, 104)	84 (68, 102)	<0.001
First door-to-device time (transfers), min	130 (101, 181)	122 (98, 164)	119 (93, 161)	114 (90, 153)	112 (89, 151)	<0.001
DIDO (transfers), min	76 (48, 125)	71 (46, 115)	66 (42, 107)	64 (40, 105)	62 (39, 101)	<0.001
STEMI performance composite score, %†	100 (87.5, 100)	100 (88.9, 100)	100 (88.9, 100)	100 (100, 100)	100 (100, 100)	<0.001

All data are presented as median (25th, 75th percentiles) unless otherwise indicated.

DIDO indicates door-in–door-out; EMS, emergency medical services; FMC, first medical contact; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

**P* value for trend test across the 5 years.

†Performance composite score includes use of aspirin, β-blockers, or angiotensin-converting enzyme inhibitors; reperfusion therapy; door-to-balloon time ≤90 minutes; statins; ejection fraction evaluation; smoking cessation; and rehabilitation referral.

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care and to set consistent expectations across mature and novel systems and regions.

BARRIERS TO IMPLEMENTATION OF STEMI SYSTEMS OF CARE

Among the barriers remaining in establishing the ideal STEMI system of care are local and regional challenges, resource and financial issues, and no single US STEMI registry. Participation in a national acute myocardial infarction registry is particularly challenging for STEMI referring hospitals, and reasonable data solutions must be developed, including the option to submit data via the STEMI receiving hospital.

Delays in care can occur at any point along the continuum. Most identified delays in a system of care are modifiable, some with moderate difficulty and others with minimum difficulty. Nonmodifiable delays should be taken into consideration during the development of primary and backup treatment, transportation, and transfer plans (Table 3).

The following are proposed nationally focused efforts to eliminate barriers in a STEMI system of care:

- Increase public awareness campaigns of heart attack signs and symptoms and the importance of calling 9-1-1; pursue individualized interventions, especially for those at increased risk (patients with prior acute coronary syndromes or known coronary artery disease)
- Develop 9-1-1 destination transport protocols by having EMS agencies, referring hospitals, and receiving centers work together
- Adopt and implement prehospital cardiac catheterization laboratory (CCL) activation and direct to catheterization laboratory protocols when appropriate for STEMI receiving centers
- Improve door-in–door-out (DIDO) times by having STEMI referring hospitals and receiving centers work together with designated interfacility transport providers
- Develop and implement regional transfer for PCI protocols and processes

Table 2. Mission: Lifeline STEMI Systems of Care, 2012 to 2019

Variable	2012	2013	2014	2015	2016	2017	2018	2019
Patients with STEMI, direct presenters, n*†	32 709	40 507	43 123	46 524	50 627	31 025	36 819	37 021
EMS FMC-to-device time, direct presenters, median min	82	81	81	80	79	81	81	82
Door-to-device time, direct presenters, median min	57	57	56	55	55	57	58	58
EMS FMC-to-device time ≤90 min, %	64.9	68.8	67.6	70.2	72.8	78.7	80	80.1
Door-to-device time ≤90 min, %	94.1	95.6	96.6	95.4	95.5	96.4	95	92.4
ED dwell time, direct presenters, median min	37	37	36	36	36	29	30	31
Patients with STEMI, transfer patient, n*†	11 468	13 326	13 607	13 948	15 144	7132	8105	7404
First door-to-device time, transfer patient, median min	106	106	105	104	104	102	102	101
DIDO, transfer patient, median min	45	45	45	45	45	47	48	48

DIDO indicates door-in–door-out; ED, emergency department; EMS, emergency medical services; FMC, first medical contact; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

*Patient numbers are cumulative.

†Decline in patients with STEMI attributed to change in data collection registry.

Table 3. Barriers to STEMI Systems of Care Implementation

Nonmodifiable	Modifiable with difficulty	Modifiable
Distance to STEMI receiving center	Patient/public knowledge of heart attack signs and symptoms (and importance of gradual onset of symptoms) and use of 9-1-1	Lack of triage protocols specific to identification of patients with STEMI
Local geography	Patient denial that signs and symptoms could be related to heart attack	Lack of preplanned reperfusion strategy
Local adverse weather conditions (air transport)	Preferred provider interfacility transport agreements	Lack of written interfacility transfer plans
Traffic	Primary PCI cardiology on-call scheduling	Unfamiliarity with fibrinolytic therapy administration
	Clinical staffing structure and CCL response	Prolonged ED dwell time
	Budgetary issues	Lack of backup transfer plan
	EMS resources	Lack of backup plans for simultaneous presentation of patients with STEMI
	EMS variability	Unclear minimum expectations for interfacility transport response and transport
	Air medical transport availability	Lack of preplanned automatic acceptance agreements between hospitals
	Corporate loyalty/market share	
	24/7/365 PCI capability	Lack of quality improvement program
		Lack of or incomplete participation in regularly scheduled multidisciplinary reviews
		Staff STEMI education

24/7/365 indicates 24 h/d, 7 d/wk, 365 d/y; CCL, cardiac catheterization laboratory; ED, emergency department; EMS, emergency medical services; PCI, percutaneous coronary intervention; and STEMI, ST-segment–elevation myocardial infarction.

- Present and discuss focused feedback with each member in the system of care
- Increase participation in active regional STEMI systems of care, including review of regional data and sharing of best practices
- Increase attention to cardiogenic shock and OHCA[8–10]

Change in policy is paramount to overcoming many of these obstacles that preclude the delivery of optimal care for all patients with STEMI, many of which also can be applied to overcoming obstacles for other acute cardiovascular emergencies such as stroke, OHCA, and cardiogenic shock. Short- and long-term policy recommendations that foster an ideal system are described below. These recommendations focus on how to maximize opportunities and improve care by enhancing the processes, acquiring new resources, or applying resources that are currently available but not fully implemented.

PUBLIC AWARENESS AND COMMUNITY EDUCATION

Community engagement is vital because identification of symptoms and prompt activation of the 9-1-1 system are the crucial first step in the STEMI chain of events.

Background

Patient delay in recognizing and acting on signs and symptoms of a heart attack is one of the greatest obstacles to timely and successful STEMI care. In the United States, the time from sign and symptom onset to the median time of first medical contact (FMC) by EMS is 87 minutes and 120 minutes when the patient presents directly to the emergency department (ED).[6] A delay in accessing care for patients with heart attack may lead to presentation with hemodynamic instability, acute heart failure, or cardiac arrest. In addition to waiting to engage the system of care, 40% of patients do not call 9-1-1 and instead present themselves to the ED, negating the opportunity for concurrent collaborative response by EMS, the ED, and the CCL.[6,11] Patients experiencing heart attack signs and symptoms should understand the importance of accessing 9-1-1. The overall goal is for the patient with STEMI to recognize and act on heart attack signs and symptoms and call 9-1-1 immediately.

Community Education Initiatives

Previous public awareness campaigns focused on these issues using campaign messaging that is simple and repetitive through print advertisements, television, radio, and, more recently, social media. Effective public education crosses cultural, socioeconomic, and psychosocial barriers and seeks to simultaneously reduce disparities in STEMI care.[12] Many campaigns using these methods have been successful. The Caruth 2 Grant in Dallas, TX, increased EMS use by 25% (2009–2016) and was associated with a declining trend in STEMI mortality from 8.5% to 6.5%.[6,12] Mississippi had long delays in STEMI care attributed to patients' self-transport to the ED and subsequently implemented a public awareness campaign

in May 2012.[6] As a result, EMS use increased from 43% to 55% (2010–2016)[6] and was associated with a reduction in FMC-to-balloon time by 75 minutes, contributing to a decrease in mortality from 6.8% in 2010 to 4.03% in 2016.

In Chicago, geocoding of OHCA allowed focused interventions targeting high-incidence neighborhoods. Through the Illinois Heart Rescue grant, collaboration with community organizations and leaders led to the creation of culturally appropriate education materials in different languages for bystander cardiopulmonary resuscitation training in high-incidence communities. As a result of these targeted interventions, the overall bystander cardiopulmonary resuscitation rate doubled over 3 years, although some neighborhood disparities persisted.[6]

Most recently, in response to coronavirus disease 2019 (COVID-19), the AHA has relaunched the Don't Die of Doubt campaign[13] and the Society of Coronary Angiography and Interventions has launched the Seconds Still Count[14] campaign, urging anyone who may be experiencing signs and symptoms of heart attack or stroke to call 9-1-1 and to call early.

A combination of approaches is important. Mass media campaigns along with individualized education by clinicians to target high-risk individuals will help address the problem from multiple intervention points. Several studies have shown that personal educational interventions (eg, addressing knowledge gaps, psychological barriers to timely treatment, involvement of a third party by encouraging patients to inform bystanders or a confidant of their symptoms) individually or as part of any visit with a health care team are able to achieve a measurable reduction in prehospital delay.[15]

It is notable that awareness that heart disease as the leading cause of death among women declined from 2009 to 2019, particularly among Hispanic, non-Hispanic Black, and younger women. Because ischemic symptoms may vary in women, campaigns targeting women are warranted.[16]

Policy Recommendations: Public Awareness and Community Education

1. Public health leaders, medical professionals, and local government officials should design and implement community education programs that focus on the signs and symptoms of heart attack, the need to seek prompt emergency care by EMS, and bystander cardiopulmonary resuscitation training.
2. Successful campaign messaging should cross social media platforms and cultural, socioeconomic, and psychosocial barriers.

ENTRY INTO THE HEALTH CARE SYSTEM

Acquisition of 12-Lead ECG: Implications for Triage

Accurate risk stratification and diagnostic testing are critical for time-dependent therapies that restore blood flow to the compromised myocardium, thereby reducing morbidity and mortality.[17] The ECG is the first diagnostic test that should be performed for patients who present to EMS or the ED with chest pain or angina-equivalent symptoms; the American College of Cardiology/AHA guideline recommends initial 12-lead ECG acquisition and interpretation within 10 minutes of FMC.[18] Prehospital 12-lead ECG acquisition is critical for determining which patients with chest pain or other suspected ischemic symptoms need to be transported directly to a PCI-capable facility.

Use of the 12-lead ECG in the prehospital setting increased from 45% to 71% between 2008 and 2012.[7] However, studies illustrate discrepancies in meeting this goal. It has been reported that although 41% of patients presenting to the ED with chest pain/angina-equivalent symptoms received an ECG within 10 minutes, a significant delay was noted for women (34 minutes for male patients versus 53 minutes for female patients).[19] Regional STEMI systems have been shown to decrease sex and age disparities.[17,20]

Patient Point of Entry Into the STEMI System of Care: Walk-In Versus EMS

Patients access health care systems by either self-transport/walk-in or EMS. Self-transport is defined as any mode of transportation that does not involve EMS services, including transport by car, taxi, or public transportation or walking to the hospital.[11,21] In the United States, 9-1-1 is the official emergency number and is managed by the Federal Communications Commission. Currently, 9-1-1 links a caller to an emergency dispatch office in >98% of locations and with a physical address in 96% of the United States.[22] Despite improvements in the management of STEMI, prehospital delays from symptom onset to seeking definitive care associated with self-transport remain problematic and represent the longest time interval in the chain of care. Patients who drive themselves or seek alternative transportation to the ED with a STEMI rather than activating EMS can delay definitive care.

Patient characteristics and outcomes differ among mode of transport to the hospital. In 2011, investigators analyzed transport data from the National Cardiovascular Data Registry Acute Coronary Treatment and Intervention Outcomes Network Registry–Get With The Guidelines to describe the prevalence of EMS transport compared with self-transport to the ED. Of 37 634 patients with STEMI, 60% used EMS transport to the hospital; these patients

were older, lived farther from the hospital, and were more likely to have hemodynamic compromise compared with patients who did not use EMS for hospital transport. Patients who lived >10 miles from the hospital had 64% greater odds of using EMS compared with those living within 4 miles. In contrast, race and neighborhood education and income levels were not significantly associated with EMS use. However, male patients were less likely to activate EMS compared with female patients. Hispanic ethnicity was associated with less EMS use, and those with private insurance were less likely to use EMS compared with patients with government-funded or no insurance.[11]

AHA focus groups identified a need for increased public awareness of the advanced capability of an EMS response that includes early identification of STEMI, lifesaving treatment, continuous cardiac monitoring, and early hospital notification. Public messaging should include how ambulance transport enables concurrent response to occur through implementation of destination protocols, transportation directly to a hospital that offers PCI for timely reperfusion, and early prehospital notification that mobilizes the CCL.

EMS Responsibilities: 9-1-1 EMS

Comprehensive EMS training should include the recognition of signs and symptoms of cardiovascular disease; acquisition and interpretation of prehospital 12-lead ECG (for patients with chest pain or other suspected ischemic symptoms and after return of spontaneous circulation for patients with OHCA); initial stabilization actions (eg, supplemental oxygen as required, blood pressure management); targeted prehospital interventions as indicated (eg, aspirin); prehospital notification with or without transmission of a 12-lead ECG; minimization of on-scene time; and determination of optimal transport destination. These critical actions have been shown to increase the chance for optimal outcomes.[23] Moreover, thresholds for EMS activation without intervention should be established (false activation) so that EMS is not discouraged from calling their findings because of negative feedback.

Initiating a 9-1-1 response to a patient experiencing signs and symptoms consistent with a heart attack brings the 12-lead ECG to the patient; early and timely acquisition of a 12-lead ECG by EMS personnel at the site of EMS FMC is a Class 1B American College of Cardiology/AHA recommendation.[18] Three basic methods are recommended for interpretation of the prehospital ECG: computer algorithm, trained paramedic read, or transmission for physician or advanced practice professional interpretation.[24] Accurate interpretation of the ECG with symptom assessment is essential for lifesaving triage and treatment decisions such as EMS destination diversion and prehospital activation of the CCL for emergency PCI.[25] Methods of interpretation, however, vary by individual EMS systems, geography, and resources. Paramedics most commonly acquire and interpret prehospital ECGs, with some states also allowing basic or intermediate EMS providers to acquire an ECG in the field.[25] Once the 12-lead ECG is acquired and interpreted, timely notification of the destination hospital of the patient with probable STEMI should trigger a STEMI alert, thereby activating the CCL team to respond and prepare for the arrival of the patient with STEMI. Early notification and prehospital CCL activation also serve to reduce treatment times and eliminate the off-peak burden encountered on nights and weekends.[26–28]

There will be occasions when patient acuity necessitates EMS transport to the closest hospital, and transport to a STEMI referring hospital is acceptable. When transportation of the patient with STEMI includes STEMI referring hospitals, EMS should complete a fibrinolytic therapy eligibility assessment for the feasibility of fibrinolytic administration. Prehospital notification of the STEMI referring hospital will allow preparation of fibrinolytic administration or the decision for prompt transfer for PCI. In locations where EMS provides interfacility transport, having EMS remain at the initial hospital for transfer to a STEMI receiving center during patient stabilization should be considered to minimize DIDO time.[29]

EMS agencies are an integral part of the STEMI system of care team. Therefore, agencies should strive to adhere to prehospital guideline recommendations, have a relationship with the destination facilities, provide specific time metrics to the ED, and expect immediate and 24- and 48-hour feedback on all patients with a suspected STEMI whom they transport. EMS agencies should participate in internal quality improvement efforts designed to examine process data for patients with time-sensitive primary impressions. EMS agencies also should be actively represented at institutional and regional STEMI multidisciplinary meetings and collaborate with other EMS agencies, STEMI referring hospitals, and STEMI receiving centers to regionalize STEMI care.

Policy Recommendations: Entry Into the Health Care System

1. Health care professionals should advocate for patients with signs and symptoms of a heart attack to call 9-1-1 for EMS transport to decrease symptom onset to arrival time and time to definitive care through well-coordinated and culturally diverse public awareness campaigns.
2. All advanced life support EMS should provide 12-lead ECGs as a standard.
3. Basic EMS providers should be trained and granted permission through certification and state protocols to acquire 12-lead ECGs on patients experiencing chest pain or other suspected ischemic symptoms, especially those with suspected STEMI, with the

findings communicated in accordance with local, regional, or state protocol.
4. EMS destination protocols should be designed to meet EMS FMC-to-PCI guideline recommendations.
5. EMS prehospital STEMI activation protocols should be developed and implemented.
6. EMS agencies should be supported appropriately with talented/trained staff, funding for acquisition, and the potential for transmission of prehospital ECGs, research funding, and backing of other groups, including cardiologists and professional societies.
7. EMS agencies should have an internal quality improvement program in place to review 100% of identified STEMIs and to provide hospital feedback on transported patients later identified as having STEMI but not identified in the field.
8. EMS should be represented at institutional and regional multidisciplinary quality improvement meetings.

STEMI REFERRING HOSPITAL RESPONSIBILITIES

STEMI referring hospitals should establish a primary reperfusion strategy: either transfer for PCI or administer fibrinolytic therapy, the latter if transport to a STEMI receiving center is not possible within the guideline-recommended time to reperfusion with PCI. Current guidelines recommend fibrinolytic therapy followed by transport to a PCI center within 3 to 24 hours. However, each STEMI referring hospital should be ready to implement the alternative option for patients in whom the primary reperfusion strategy cannot be implemented. STEMI referring hospitals should have an established primary and backup plan for timely and efficient transfer of a patient with a suspected STEMI who presents to that facility. This starts with rapid interpretation of the 12-lead ECG within 10 minutes of the patient's arrival. The diagnosis of STEMI should lead to an immediate activation of the transfer protocol. The STEMI referring hospital should have an algorithm to follow that describes the step-by-step procedure for the care of the patient and the initiation of transport. Some facilities may have a "STEMI box" (toolkit) that has the agreed-on desirable medications and the algorithm and necessary forms for transfer. The algorithm should be evidence based and limit the number of decisions in this time-critical event. For example, omitting intravenous infusions of medications and avoiding unnecessary chest x-rays are recommendations for improving throughput.

Even when pre-established transfer agreements are in place, there should be direct physician (or advanced practice professional)-to-physician communication between the STEMI referring hospital and STEMI receiving center, but this should not delay the transfer process. Mission: Lifeline reporting measures include a DIDO (arrival/registration to transfer out of the ED) time of ≤30 minutes. Delays in DIDO have been described and result in higher mortality.[30]

PCI is the preferred approach over fibrinolytic therapy in an acute STEMI if the intervention can be performed within 120 minutes of FMC before arrival at the STEMI referring hospital.[18] Facilities should preplan for the distance to the preferred STEMI receiving center and the readiness of that facility for immediate PCI. If fibrinolytic therapy is given, there should be a protocol-driven administration of adjunctive medications to optimize successful reperfusion.

Efficiency in timely recognition of the STEMI and rapid management of the transfer process are difficult on a 24 h/d, 7 d/wk (24/7) schedule in any referring hospital. Appropriate resources, protocols, ongoing staff training, and direct participation in a national STEMI registry to compare hospital STEMI performance with regional performance and national benchmarks should be implemented. Performance should be measured frequently at multiple intervals to ensure success of the transfer process and optimal care of the patient. In the rare circumstance in which transfer to a PCI center is not appropriate, patients remaining at the STEMI referring hospital after effective reperfusion with fibrinolytic therapy should receive guideline-directed medical therapy (GDMT) and referral to a cardiac rehabilitation program.

STEMI referring hospitals should also engage in activities that promote a regional STEMI system of care, attend multidisciplinary meetings, and collaborate with EMS (9-1-1 and interhospital transport), other STEMI referring hospitals, and STEMI receiving centers to regionalize STEMI care.

In addition to STEMI readiness, STEMI referring hospitals should maintain a high level of readiness to receive and treat patients with OHCA and to apply interhospital transfer processes used for patients with STEMI.

INTERHOSPITAL EMS TRANSPORT PROVIDER RESPONSIBILITIES

Interhospital transporting agencies may be a privately owned transport ambulance provider with or without a contractual relationship with at least one of the hospitals, a ground or air ambulance provider, or a community 9-1-1 EMS interhospital transport service for critically ill patients with time-dependent diagnoses such as STEMI.

Interhospital transfer of critically ill patients in need of a higher level of specialized care has been performed safely and successfully for various medical and surgical emergencies for decades.[2] With studies indicating that primary PCI is superior to fibrinolytic therapy for the treatment of STEMI, the need for emergency transfer of

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appropriate patients to a facility with invasive resources became urgent.[1] Timely interhospital transport of patients with STEMI, many of whom may be medically unstable, may have received fibrinolytic therapy, and may have intravenous infusions of vasopressors and antiarrhythmic medication, presents significant challenges. Rapid and safe transfer of patients with STEMI by medically trained personnel is necessary to meet established goals, including DIDO of ≤30 minutes and door-to-device time of ≤120 minutes.[18] It is imperative that the interfacility transport agency shares its scope of practice with the STEMI referring hospital so that there is an understanding when certain intravenous medications may require hospital personnel to accompany the patient or specialized EMS personnel for transport.

Rapid access to critical care ambulance services for timely interhospital transfers has been lacking in many areas of the United States. Transfer of patients with critical, time-sensitive conditions, although successful in many areas, has been plagued with multiple system delays. Extended arrival times of the agency providing interhospital transfer may be life-threatening for the patient with STEMI or cardiovascular-compromised patients. The expectation is for prompt ambulance service response at the referring hospital. A system goal of interhospital transport arrival in ≤15 minutes, for example, is reasonable, but it is also important that the hospital pretransfer process is committed to have the patient ready for transfer on or before the transport team's arrival. Some EMS agencies such as that in Los Angeles County have changed policies to meet this shortened goal. STEMI referring hospitals in that county have a protocol to call 9-1-1 and request paramedics to transport the patient with suspected STEMI to a STEMI receiving center, often bypassing the receiving hospital's ED. In Los Angeles County, EMS has bypassed the nearest hospital without PCI availability for >8 years. EMS bypass has added only a median of 5 minutes and is not associated with any increase in mortality.[31] In other areas, non–9-1-1 EMS ambulance services may also meet these goals. Engagement of the STEMI network through calling 9-1-1 has been shown to substantially affect mortality across multiple systems.

STEMI RECEIVING CENTER RESPONSIBILITIES

Most of the responsibility for timely invasive care of the patient with suspected STEMI has focused on patients directly presenting to the receiving center, either by EMS transport or by non-EMS means. Receiving centers should have clear processes for rapid identification and timely treatment and throughput of the patient with acute STEMI. Collaboration with EMS is essential in the STEMI system of care. Implementation of prehospital STEMI activation protocols, with EMS engagement, promotes early CCL readiness and contributes to a decreased length of stay in the ED, which has been shown to decrease mortality.[27] All EMS agencies transporting patients to the STEMI receiving center should receive follow-up on all patients with potential STEMI within 24 to 48 hours of arrival, be invited to attend multidisciplinary meetings, and contribute to the discussion of improved outcomes. The most recent guidelines state that arrival to PCI (door-to-device time) should occur within 90 minutes; however, many institutions are regularly achieving times of <60 minutes, and consideration should be given to this potential new standard during reviews for quality improvement.

Receiving interhospital transfer patients with STEMI adds further demands to the STEMI receiving center responsibilities, including prearranged acceptance agreements with referring hospitals, direct communication between facilities, prehospital registration, direct to CCL transport, and expected shorter door-to-device time of ≤30 minutes. The STEMI referring hospital must be able to initiate the transfer process with certainty of CCL and interventional cardiologist availability at all times. A single call activation approach reduces the transfer burden for both the receiving and referring facility and should be implemented to serve the patients transferring for PCI. Receiving centers should provide outreach to referring hospitals within their catchment area that includes rapid activation pathways for STEMIs with expedited access to cardiologists. This outreach could also include preferred treatment algorithms for STEMI care to simplify the burden of the referring hospital of caring for the patient while striving to meet the time goals of the transfer. In addition, as a regional resource, the STEMI receiving center should provide timely feedback to the referring hospital about the patient's outcome and review and transparently share the process measures from the patient's onset of symptoms to device deployment and hospital course.

STEMI receiving centers should preplan for simultaneous presentation of patients with STEMI. This may include diversion to another STEMI receiving center if necessary.

STEMI receiving centers are the hub of STEMI care. They should participate in a national STEMI database to compare hospital STEMI performance to regional performance and national benchmarks. They should also engage in activities that promote a regional STEMI system of care, coordinate multidisciplinary meetings, and collaborate with other STEMI receiving centers to regionalize STEMI care.

RECOMMENDED LEVELS OF CARE

Level III Acute Heart Attack–Ready

Acute heart attack–ready hospitals are committed to identifying patients with STEMI, assessing the onset of symptoms, and providing consistent and optimal GDMT. These facilities are skilled in working within their system of care (EMS, interfacility transfer team, PCI-capable hospitals) to provide timely transfer of the patient with

Table 4. Level of Care Characteristics*

Heart attack level	AHAR hospital	PHAC	CHAC
Alternative name of heart attack level	Level III	Level II	Level I
Designation characteristics	24/7/365 STEMI referring hospital	24/7/365 PCI capable	24/7/365 STEMI receiving center: cardiac surgery on site, cardiogenic shock, advanced hemodynamic support, OHCA support
Annual PCI volume (institutional), n†‡	NA	≥150	≥400
Annual primary PCI institutional volume, n‡	NA	≥36	≥36
Annual PCI volume (provider), n‡	NA	≥50	≥50
Annual primary PCI volume (provider), n‡	NA	≥11	≥11
Circulatory support (IABP)	NA	Required	Required
Advanced circulatory support (eg, ECMO, LVAD)	NA	Not required	Required
Cardiac surgery on site	NA	Not required	Required
Cardiogenic shock support	NA	Not required	Required
Comprehensive postarrest care, including TTM	TTM required	TTM required	Comprehensive postarrest care including TTM required
Rapid response team	NA	Required	Required
Cardiothoracic intensive care unit	NA	Not required	Required
Coronary intensive care unit	NA	Required	Required
Cardiac rehabilitation services	Locally available	Locally available	Locally available
Fibrinolytic administration capability	Required	Required	Required
National AMI data registry participation	Required	Required	Required
Transfer agreement	Required transfer agreement in place with Level I or Level II facilities	Required transfer agreement in place with Level I (PHAC) when advanced levels of critical care needed	Required transfer agreements in place to accept patients from Level II and III facilities requiring advanced care
Regional system of care engagement	Required	Required	Required
Other criteria			Air medical transport with advanced circulatory support (eg, ECMO, LVAD) services

24/7/365 indicates 24 h/d, 7 d/wk, 365 d/y; AHAR, acute heart attack–ready; AMI, acute myocardial infarction; CHAC, comprehensive heart attack center; ECMO, extracorporeal membrane oxygenation; IABP, intra-aortic balloon pump; LVAD, left ventricular assist device; NA, not applicable; OHCA, out-of-hospital cardiac arrest; PCI, percutaneous coronary intervention; PHAC, primary heart attack center; STEMI, ST-segment–elevation myocardial infarction; and TTM, targeted temperature management.

*Requirements must be consistent with the most recent American Heart Association guidelines and statements.

†Definitive health care data for 2018 all-payer STEMI claims (AHAR hospital average annual volume, 96; PHAC average annual volume, 362).

‡American College of Cardiology/American Heart Association clinical competence statement 2013 (hospital and operators must meet volume or alternatives stated in the document).

STEMI to a 24/7/365 (365 d/y) PCI-capable hospital for appropriate care. If indicated, acute heart attack–ready hospitals also can administer fibrinolytic therapy as the reperfusion strategy for lytic-eligible patients when the facility cannot achieve transfer for PCI reperfusion times within the recommended guidelines. In addition, acute heart attack–ready hospitals also use the AHA's Get With the Guidelines–Coronary Artery Disease program or other national registries to collect data and to perform continuous evaluation and quality improvement to increase efficiency and adherence to GDMT (Table 4).

Level II Primary Heart Attack Center

Primary heart attack center hospitals also provide GDMT to identified patients with STEMI. However, in addition, they are capable of performing primary PCI 24/7/365 in hemodynamically stable patients with or without an intra-aortic balloon pump (Table 4). Facilities that are available to perform primary PCI only during specific hours challenge the STEMI systems of care with lack of consistency. This can delay appropriate patient triage; thus, these hospitals should not be considered primary heart attack center hospitals. Patients with STEMI requiring advanced hemodynamic support devices or comprehensive cardiac arrest care are transferred to a Level I comprehensive heart attack center (CHAC).

Level I Comprehensive Heart Attack Center

A Level I CHAC is defined as any hospital that has 24/7/365 primary PCI available for the management of STEMI and has adequate levels of system-wide care to manage the most critically ill patients. This includes an

integrated system of care involving the EMS system, ED, CCL, cardiology service, cardiothoracic surgery service, and critical care to facilitate optimal care. These systems are required to maintain optimal door-to-device times and to manage patients received by the hospital directly from home or the community, by EMS, and by transfer from non–PCI-capable facilities. An appropriate system in place is required to decrease and maintain short door-to-device times, facilitated by prehospital STEMI activation when possible, ED physician CCL activation when the patient is in the ED, and single-caller systems for referral hospitals.[32–36]

A CHAC is required to have the full range of advanced hemodynamic support for the treatment of the most complex and critically ill patients, including those with cardiogenic shock and OHCA. Cardiogenic shock complicates STEMI in 5% to 15% of patients and is the most common cause of in-hospital mortality.[8,9] AHA recommendations call for coordinated care of the patient with cardiogenic shock that includes specialists such as cardiothoracic surgeons, interventional cardiologists, advanced heart failure specialists, critical care specialists, and allied health professionals as part of the available treatment team. Resources that should be available to these patients at a CHAC include options for mechanical circulatory support. However, it should be noted that robust data from adequately powered randomized trials evaluating the risks and benefits of mechanical circulatory support are lacking. Therefore, an individualized approach to care with consideration of early mechanical support before PCI for patients with refractory hemodynamic instability despite aggressive medical therapy is recommended.

With the development of destination protocol criteria similar to those for bypassing a non-PCI hospital, specification of when it is best to transport to the closest facility and direct transport of patients with cardiogenic shock to a Level I CHAC should be part of a regional STEMI system design.

Moreover, patients at CHACs may require invasive hemodynamic monitoring, inotropic agents, mechanical ventilator support, renal replacement therapy, and escalation of heart failure management strategies. Availability of options to meet the needs of the patient and deliver best-care practice standards at these facilities with the expertise, clinical volumes, and patient resources to provide a multidisciplinary approach is required to optimally care for critically ill patients with STEMI.

In addition, CHACs should be cardiac arrest centers, indicating the availability of a multidisciplinary team and resources available to care for patients with STEMI complicated by cardiac arrest. These specialized centers provide contemporary and comprehensive evidence-based resuscitation and postarrest care, including emergency cardiac catheterization, targeted temperature management, and multimodal prognostication.[34] These evidence-based therapies have been demonstrated to double neurologically intact survival from cardiac arrest[4] (Table 4).

Policy Recommendations: STEMI Referring Hospitals, Interhospital Transport, and STEMI Receiving Hospitals

STEMI referring hospitals and STEMI receiving centers have specific roles in a STEMI system of care, and each should be as prepared as possible to collaboratively perform evidence-based, lifesaving treatment.

Transferring patients from a STEMI referring hospital to a STEMI receiving center is part of a continuum of care that should establish hand-off and transfer protocols, including backup plans and procedures that ensure safe patient care and rapid transfer between facilities. Protocols for interhospital transfer should be established and approved beforehand so that efficient patient transfers can be accomplished at all hours of the day and night. The basic protocols for interhospital transfer of patients may be facility based but developed and approved at a regional level to further enhance and regionalize the system of care.

1. STEMI referring hospitals should have a planned reperfusion strategy in place (either fibrinolytic administration or transfer for PCI).
2. A 9-1-1 call system should be used for requesting interhospital transfer (in the absence of immediately available hospital-based transport services).
3. Interhospital request time to arrival time should be within 15 minutes.
4. STEMI referring hospitals and STEMI receiving centers should have preplanned agreements in place.
   a. One-call transfer process
   b. Automatic acceptance
   c. Treatment algorithms
   d. Transfer processes (primary and backup)
5. STEMI receiving centers should have protocols in place to be able to quickly treat the patient with STEMI arriving by interhospital transfer.
6. STEMI receiving centers should strive to meet overall arrival-to-PCI (device time) within 90 minutes but strive for within 60 minutes and within 30 minutes for transferred patients with STEMI.
7. STEMI receiving centers should take the lead on coordinating multidisciplinary care and engaging STEMI referring hospitals, interhospital transport agencies, and EMS.
8. All hospitals and EMS agencies should be active participants in a regional system of care.

TRANSITIONS OF CARE

ED to CCL Transition

To expedite care and reduce redundancy, minimizing the time in the ED at the receiving hospital is imperative. There are many practical considerations to limit this time that should be considered in all patients, including keeping the patient on the EMS stretcher until arrival of

the CCL team, not repeating a good-quality prehospital ECG that shows STEMI, and avoiding unnecessary protocol-driven procedures, including chest x-rays in patients without specific indications. Other considerations to expedite the time of ED care depend on the timing of prehospital activation of the CCL.

Movement of the patient directly to the CCL or bypass of the ED to manage the patient with STEMI with more rapid definitive care was shown to decrease the door-to-device time and was associated improved mortality.[35,36] Immediate transfer to the CCL is much more likely with prehospital diagnosis of STEMI and preactivation of the CCL.[37] Unfortunately, this does not occur with most STEMIs and is variable in STEMI centers across the country.[27] It also occurs more often during daylight hours, which supports the need for improved preactivation. Effective direct to CCL transport depends on prehospital notification in response to STEMI being diagnosed through medic interpretation with quality improvement validation, machine read, or transmission with diagnosis by a physician.[38] Bypass of the ED needs to be performed with consideration for patient safety; prehospital notification of a change in patient status should occur. Transfer of the patient to the CCL before the arrival of all the necessary staff and especially before the arrival of the interventional cardiologist can create a situation in which there is increased risk to the patient. When there is communication with the interventional cardiologist, the ED physician or advanced practice professional may accompany the patient to the CCL to await arrival of the interventional cardiologist. Preferably, the CCL staff and interventional cardiologist are waiting to receive the patient in the ED to escort to the CCL and perform a focused history and physical examination. The report from EMS to the CCL nurse should be efficient and accurate, especially detailing medications that have been given in the prehospital setting or at a referring facility.

For patients presenting directly to a STEMI receiving center by self-transport or EMS, direct transport to the CCL should proceed with caution to be certain that evaluation for aortic dissection, pulmonary embolus, or central nervous system bleed (in the setting of cardiac arrest and head trauma) is not indicated before the anticipated PCI.

When immediate transfer to the CCL is not feasible because of patient instability or because the CCL is not prepared to receive the patient, the patient will wait in the ED. The dwell time in the ED should be minimized and should be monitored and reported as part of quality outcome measures in STEMI systems of care. While the patient is in the ED, medical management of the patient should begin with anticoagulation and aspirin. A $P2Y_{12}$ inhibitor can be considered for loading in the ED but may be deferred until after the coronary angiogram is performed. If there is a prolonged logistical delay in PCI, there should be more compelling consideration to load with $P2Y_{12}$ inhibitors. Processes such as drawing of blood for laboratory values, initiation and verification of patent intravenous lines (contralateral arm if radial artery access is anticipated), femoral access preparation, and placement of radiolucent monitor pads or defibrillator pads can be completed in the ED unless any of these processes slows transfer to the CCL.

The transfer of unstable patients necessitates an even greater level of coordination of care and communication, but many times, because of the complexity of the patient and the urgency to get definitive care, transfer to the CCL is performed in an expedited fashion. Hemodynamic stabilization of the patient also should be accomplished before transfer to the CCL or until the interventional cardiologist confirms that the CCL is ready to receive an unstable patient. Patients with ongoing chest compressions on arrival to the ED should be evaluated in the ED with history and outcomes risk assessment before proceeding with coronary angiography/advanced mechanical support (lactate, capnography, pH, history of arrest, vasopressors given in field) to avoid taking a patient at excessive risk or futility to the CCL and to consider a patient for primary hemodynamic support intervention. Performance of a prehospital ECG has been shown to improve the number of patients with OHCA taken to STEMI receiving centers, but there is still significant opportunity for proper transport decisions in these critical patients.[39]

Occasionally, there will be a prolonged ED dwell time. This may occur if there is simultaneous STEMI arrival or a prolonged ongoing procedure in the CCL. Management of the patient will be planned through ongoing communication with the CCL team as to timing of room and staff availability. If revascularization time is likely prolonged, fibrinolytic therapy should be considered. If the CCL is not able to take a patient with STEMI immediately for the reasons previously enumerated, prehospital communication with EMS should encourage diversion to another receiving center if possible. There should be no diversion of the patient after arrival at the STEMI receiving center.

CCL to Floor/Intensive Care Unit

Systems should be in place for postrevascularization transfer to critical care units (medical intensive care unit or coronary intensive care unit) by critical care–trained and advanced cardiac life support–certified nursing and paraprofessional teams. Stable post-PCI patients with STEMI may also be followed on a step-down unit. Consideration should be given to applying a risk stratification tool (eg, Zwolle score <4) to identify low-risk patients who could be safely transferred to a step-down unit and targeted for early discharge.[40,41]

Inpatient care should be provided by cardiologists in conjunction with multidisciplinary consultative services as determined by the clinical needs of the patient. GDMT should be initiated, barring clinical contraindications, and telemetry monitoring should be continued for a minimum of 48 hours or until discharge if within 48

hours. Nonculprit artery revascularization should be managed according to contemporary clinical guidelines. For patients with cardiogenic shock at presentation or during hospitalization, treatment with advanced mechanical circulatory support devices should be initiated early; systems without such capabilities should have mechanisms in place for urgent postrevascularization transfer to centers with these resources.

Hospital to Home

On discharge from inpatient care, patients should be on maximally tolerated GDMT with outpatient follow-up with a primary care physician or advanced practice professional and cardiologist in accordance with a transitional care management plan. Whenever possible, systems should be in place with local pharmacies and medication assistance programs to ensure supply of dual antiplatelet therapy and other medications. Referral to cardiac rehabilitation programs should be ensured before discharge. For patients with heart failure despite revascularization, referral to a heart failure clinic for longitudinal care should be considered.

Home to Cardiac Rehabilitation

After discharge with referral to cardiac rehabilitation programs as part of routine post–myocardial infarction care, systems should be in place to track successful enrollment ideally within 21 days after discharge.[42]

Policy Recommendations: Transitions in Care

1. The CCL should be activated as early as possible before arrival of the patient with STEMI at the hospital in order to provide definitive revascularization with the greatest efficiency, especially for high-risk patients.
2. Time in the ED should be minimized and not delayed by nonessential tests.
3. If the CCL is ready to receive the patient with STEMI, the ED should be bypassed, and direct transport to the CCL should occur for most patients.
4. After PCI, in-hospital care in the appropriate setting should include GDMT and transitional care management at discharge.
5. Patients with STEMI should receive a referral for cardiac rehabilitation from an inpatient setting.

POST–HEART ATTACK CARE/ REHABILITATION

A system of care should ensure that all patients have access to post–heart attack care (ie, discharge planning services, patient education, cardiac rehabilitation, nursing facilities, medical follow-up) regardless of their financial status or socioeconomic background. Such availability will ensure that each patient has the opportunity to achieve maximal recovery from a heart attack, to optimize cardiovascular health, and to decrease the likelihood of a recurrent heart attack. This will ultimately reduce the societal and economic impacts of STEMI.[43]

Cardiac rehabilitation is a systematic, multidimensional, evidence-based service that provides rehabilitation and secondary prevention therapies to individuals after STEMI and acute coronary syndromes.[44] Referral to and participation in cardiac rehabilitation are strongly endorsed in clinical practice guidelines, performance measures, and core quality metrics for optimal acute coronary syndrome care. A growing body of evidence supports the positive impact of cardiac rehabilitation services on a variety of patient outcomes, including mortality rates and recurrent cardiovascular events, as well as rehospitalization rates, functional capacity, psychological health, adherence to secondary prevention therapies, and health care costs.[45–48]

Post–myocardial infarction cardiac rehabilitation starts at the time of hospitalization, when secondary prevention therapies are initiated and the referral process to early outpatient cardiac rehabilitation takes place. Ideally, coordination of cardiac rehabilitation services can occur before discharge. Soon after hospital discharge, patients typically enroll in early outpatient cardiac rehabilitation and continue for the total number of recommended sessions, usually spread over ≈12 weeks. Patients receive lifestyle counseling, undergo supervised progressive exercise training, and have comorbid conditions assessed and addressed (eg, diabetes, hypertension, hyperlipidemia, depression, anxiety, sleep disorders, musculoskeletal limitations). Responses to therapy are assessed, and treatment changes are coordinated as needed in collaboration with the patient's primary health care professional. At the end of early outpatient cardiac rehabilitation, patients continue to follow a maintenance cardiac rehabilitation regimen that is based at home, in a community-based fitness center, or in a center-based cardiac rehabilitation program (phase 3 cardiac rehabilitation).[43] Early outpatient rehabilitation includes center-based care and home-based care for patients who are not able to participate outside of their home.

National data have shown that cardiac rehabilitation participation is low, 20% to 30%, with considerable variability between centers.[49] Participation in cardiac rehabilitation is particularly low in the elderly, women, and individuals from underserved racial and ethnic groups, as well as in rural and remote areas. Systematic approaches for patient referral to and enrollment in cardiac rehabilitation such as the use of automatic referral systems or prepopulated order sets have been shown to help overcome patient, physician or advanced

practice provider, and health system barriers to cardiac rehabilitation and to dramatically improve cardiac rehabilitation participation rates.[43] However, despite the beneficial effects of systematic approaches to improve cardiac rehabilitation participation, the national capacity of cardiac rehabilitation programs appears to be insufficient to provide care to all eligible patients.[50] New methods are being developed and tested to expand cardiac rehabilitation capacity and participation, including home- and community-based approaches, aided by the use of mobile and smartphone technology tools. Performance and quality measures aimed at improving cardiac rehabilitation participation and outcomes have been developed, endorsed, and published by the American College of Cardiology/AHA for appropriate cardiac rehabilitation referral, enrollment, time to enrollment, and adherence.[51]

Policy Recommendations

1. Guideline-based secondary prevention should be a key component of strategic protocols in STEMI systems.
2. Health care systems and practices should implement evidence-based strategies that optimize patient outcomes associated with cardiac rehabilitation referral, early enrollment, and adherence. These strategies should include accountability and quality improvement activities (eg, performance measures).
3. Third-party payers should incentivize cardiac rehabilitation participation through coverage and reimbursement policies.

SPECIAL CONSIDERATIONS

Telemedicine

Telemedicine encompasses the prehospital transmission of ECGs and other biometrics that are collected by modern monitor defibrillators, as well as the use of applications that leverage the transmitted information from EMS to members of hospital teams that can include the ED, cardiologist, house bed control, and CCL personnel, among others. It can also include telephonic online medical direction by the emergency physician (or advanced practice professional) or the receiving cardiologist. Well-designed systems can convey critical information without significantly increasing the burden on EMS crews. As stated below, the use of these technologies may be incrementally more important in rural and remote environments in which additional resources may need to be accessed. Telemedicine may be used at such facilities to obtain expert consultation for complex management such as the use of "electronic intensive care unit" care.[52]

Rural Environments

Nineteen percent of the US population lives in rural areas. The term rural typically describes nonmetropolitan areas that are geographically distant from large population centers with a low density of individuals. They are typically served by a single health care setting with limited or modest health care resources that is unlikely to be able to provide PCI. Patients in rural communities face particular challenges in receiving optimal care for STEMI. The odds of untimely access to PCI is significantly higher in rural areas.[46,53] Although the reasons for this finding are multifactorial, systems of care should be created to address and mitigate the individual contributing factors to the extent possible.

Challenges in the rural setting are largely self-evident. In the prehospital setting, EMS crews are often volunteers; ambulance staffing and crew training pose perennial challenges. The providers are less likely to be at the paramedic level, so advanced life support care may not be generally available.

Rural EMS typically encounters a low volume of patients; the paucity of patients managed for STEMI may lead to a lack of familiarity with the protocols. The ability to obtain a field ECG may be constrained by lack of equipment and EMS scope of practice rules that may not permit basic EMS providers with lower certification levels to obtain or transmit an ECG. In addition, rural EMS agencies in general have fewer resources compared with urban systems, so response times are longer as a result of competition for these resources and the distance traveled. Similarly, the distance to the nearest receiving facility may be too far to achieve guideline-recommended metrics.

Rural hospitals face similar challenges in personnel training and expert availability. Not all hospitals will have access to onsite cardiology, and hospitals are unlikely to have access to a CCL. Interfacility transports are more challenging with fewer resources for transport and longer distances involved. This can be hindered by weather and transport restrictions. Recognizing these collective challenges, programs to speed initial assessment, transfer, and treatment can improve the timeliness of PCI.[54] Critical access hospitals arose to stem closures of rural hospitals during the 1980s and 1990s. Congress enacted legislation to reduce the financial vulnerability of rural hospitals and thereby ensure access to this service in rural communities. Conditions that critical access hospitals have to meet include <25 beds, location >35 miles from another hospital (exceptions exist), and full-time emergency services with staff either onsite or available with a 30-minute callback.[55] Frontier areas are allowed a longer response time. Despite the support, critical access hospitals continue to show attrition.

There are additional challenges to timely STEMI care. Critical access hospitals may not stock fibrinolytic

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therapy because of the expense, inconvenience of refrigerated storage, and infrequent use. The prehospital use of fibrinolytic therapy has been studied and demonstrated to be safe and effective through remote reading of the 12-lead ECG and online medical direction, as well as offline use prescribed by explicit protocols, particularly in air medical settings. However, prehospital use of fibrinolytic therapy is not recommended in guidelines. Furthermore, adjunctive therapy with clopidogrel, heparin, and aspirin needs to be emphasized for success of any fibrinolytic revascularization strategy. In the absence of physicians or advanced practice professionals, nurses or other allied health personnel should be able to administer these drugs with proper oversight by telephone or telemedicine consultation.

Many transportation factors (type, time, distance, weather) determine how rapidly the patient's care can be transitioned to a higher level of care. The distance to the next level of care may dictate ground versus air transport. Some EMS systems may not have sufficient staffing or qualified staffing to safely provide ground transport despite what may seem to be favorable ground distances, especially when this may take limited local EMS out of service during transport. Weather and flight rules (day/night) and access to rotor-wing versus fixed-wing aircraft will affect potential transfer times. Systems must be encouraged to establish memoranda of agreement with flight services and receiving facilities; to preplan for various scenarios involving permutations of weather, EMS or air medical transport availability, and staffing; and to attempt to create decision trees to address these issues.

Policy Recommendations: Special Considerations

1. Telemedicine services should be considered and developed when appropriate to expedite the provision of timely primary PCI.
2. Rural hospitals should collaborate with regional STEMI receiving centers for access to best practice, emergency expertise (telemedicine), PCI services, and advanced care settings (intensive care units).
3. Rural hospitals should work with area stakeholders to develop prehospital response and triage protocols, incorporating local hospital and potential air medical transport.
4. Rural hospitals should develop ED-based treatment protocols for rapid assessment for fibrinolytic therapy administration and consideration of transfer for PCI based on mutually developed protocols with the PCI receiving center.
5. Regional stakeholders should establish rapid interfacility transport mechanisms for patients requiring PCI or a higher level of acute care.
6. Rural hospitals should participate in institutional and regional multidisciplinary quality improvement programs.
7. Regional tertiary care centers should provide feedback to and assist in process improvement with the rural hospitals in their region for all patients transferred for a higher level of care.

FINANCIAL CONSIDERATIONS

The financial ramifications to hospitals and EMS systems when the reimbursement structure is not balanced are significant. If a referring hospital does not receive adequate reimbursement for the services it renders and all the funds go to the receiving center, then the incentives are not aligned.

For the system of care to function smoothly, all of the components should be assured that their services can be recognized. For example, if the EMS system is not remunerated for the performance of the 12-lead ECG in the field, it has less incentive to bring that technology to the community.

Within a system of care, protocols and standard policies allow the close tracking of outcomes and provide excellent quality dashboards against which the components can be measured. This allows reimbursement to be tied to performance and provides a forum for public reporting.

In addition, it is important for third-party payers and government agencies to recognize that significant funding is warranted in light of the quality improvements, that is, a 30% reduction in mortality attributable to cardiovascular disease in the United States in the past 10 years. This payment policy could be a global payment for services that recognizes the roles of each of the components of the system of care. The hope is that this will incentivize those institutions to invest in the services to care for their community of patients.

A good example is the development of cardiac rehabilitation programs in the referring hospitals to support patients after discharge. Cardiac rehabilitation improves outcomes and reduces readmissions while reducing long-term expenditures.[56] Support of reimbursement will aid in the dissemination of these services close to the communities where these patients reside.

Policy Recommendation: Financial Considerations

1. There should be support for the global reimbursement of the system of care for the patients with STEMI with recognition of each of the components, including referring hospital, receiving center, EMS transport and transfer, and ancillary services.

COMPREHENSIVE CARDIAC CENTERS

Comprehensive cardiac center certification enhances cardiovascular patient care, seeking to improve outcomes and quality of life for patients. Centers deliver care and treatment to the cardiovascular patient population, along with risk factor identification and disease prevention strategies.

The comprehensive cardiac centers should have a robust cardiovascular program that focuses on the triage, risk stratification, management, and postacute care of patients with cardiovascular conditions, including acute coronary syndromes (STEMI, non-STEMI, and unstable angina), OHCA, cardiogenic shock, dysrhythmias, valve disease, and heart failure. Comprehensive cardiac centers also should ensure access to all treatment modalities and therapies for Level I STEMI receiving centers (Table 4). Enhanced communications provide for consultation, referral, and transfer arrangements from the ED visit to diagnosis, treatment, and follow-up and through outpatient and transitions of care.

Comprehensive cardiac centers rely on an integrated systems of care approach, streamlining care across the cardiovascular service lines, zeroing in on disparities in care delivery, focusing on areas for quality improvement, and emphasizing the importance of taking a population health perspective that expands above and beyond a STEMI system of care as a cardiovascular system of care.

Certified hospitals are concerned with outcomes of the cardiovascular patient population and therefore measure key indicators in 9 specific domains in the continuum of care: acute myocardial infarction; STEMI; PCI; diagnostic cardiac catheterization procedures; coronary artery bypass grafting; valve replacement or repair; implantable cardioverter defibrillator procedures; heart failure; and cardiac rehabilitation. Centers identify and establish hospital-specific goals, set clinical priorities, and develop quality improvement programs that define and measure specific outcomes of care. Certified comprehensive cardiac centers are STEMI receiving centers that also provide complex cardiovascular care and additional cardiovascular interventions. Thus, comprehensive cardiac centers should meet all the requirements of a CHAC.

IDEAL FUTURE STATE

Moving forward, continued implementation of systems of care for STEMI, cardiogenic shock, stroke, OHCA, and aortic dissection, among other time-sensitive cardiovascular disorders, should be pursued with ongoing commitment to improve the quality of care and outcomes for all patients with cardiovascular emergencies. Avoiding patient delay after the onset of recognized symptoms, accessing 9-1-1, following EMS destination protocols and prehospital cardiac CCL activation, using 9-1-1 when interhospital transport is necessary, and bypassing the ED when appropriate will achieve these goals. Breaking down silos within a region where EMS, referring hospitals, and receiving centers work together to provide guideline-directed, evidence-based therapies across the continuum of care that includes secondary prevention should be supported and fostered by continuously monitoring quality metrics and outcomes.

IMPLICATIONS OF THE COVID-19 PANDEMIC

The COVID-19 pandemic has imposed unprecedented disruptions in our health care system in the United States and across the world, affecting even the most advanced systems of care. With the utmost goal of maintaining patient and health care worker safety, inherent delays are expected related to patient screening and testing, donning of appropriate personal protection equipment, ambulance decontamination and restocking, triage protocols at hospital arrival, and new CCL preparations/readiness.

Moreover, there has been concern about the reported decrease in the number of patients with STEMI (and stroke) presenting to hospitals by either EMS or self-transport.[57] Perhaps now more than ever, systems of care are critically important to ensure that patients with STEMI, cardiogenic shock, OHCA, or stroke continue to receive lifesaving treatments. There should be added emphasis on advising patients to call 9-1-1 at the onset of symptoms to help offset the necessary delay to definitive treatment. Patients must be reassured that appropriate precautions have been implemented by EMS and hospitals to protect them and health care workers from COVID-19 infection.

PCI should remain the primary and preferred reperfusion strategy for patients with classic STEMI on the basis of superior outcomes with PCI compared with fibrinolytic therapy.[58]

Regionalized care that facilitates sharing best practices, necessary resources, data, and experiences and decreasing barriers to care will fuel a bold response to what is hoped will be a once-in-a-lifetime challenge. Moreover, the lessons learned from the COVID-19 pandemic will result in the identification of innovative collaborative approaches to improve care. Only then will we be prepared to maintain evidence-based cardiac care and the tenets of our collective systems of care success as COVID-19 waxes and wanes in the coming months.[58]

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing

panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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Writing Group Disclosures

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

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