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# Regionalized Care for Time-critical Conditions: Lessons Learned From Existing Networks

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## Abstract

The 2010 *Academic Emergency Medicine (AEM)* consensus conference “Beyond Regionalization” aimed to place the design of a 21st century emergency care delivery system at the center of emergency medicine’s (EM’s) health policy research agenda. To examine the lessons learned from existing regional systems, consensus conference organizers convened a panel discussion made up of experts from the fields of acute care surgery, interventional cardiology, acute ischemic stroke, cardiac arrest, critical care medicine, pediatric EM, and medical toxicology. The organizers asked that each member provide insight into the barriers that slowed network creation and the solutions that allowed them to overcome barriers. For ST-segment elevation myocardial infarction (STEMI) management, the American Heart Association’s (AHA’s) *Mission: Lifeline* aims to increase compliance with existing guidelines through improvements in the chain of survival, including emergency medical services (EMS) protocols. Increasing use of therapeutic hypothermia post-cardiac arrest through a network of hospitals in Virginia has led to dramatic improvements in outcome. A regionalized network of acute stroke management in Cincinnati was discussed, in addition to the effect of pediatric referral centers on pediatric capabilities of surrounding facilities. The growing importance of telemedicine to a variety of emergencies, including trauma and critical care, was presented. Finally, the importance of establishing a robust reimbursement mechanism was illustrated by the threatened closure of poison control centers nationwide. The panel discussion added valuable insight into the possibilities of maximizing patient outcomes through regionalized systems of emergency care. A primary challenge remaining is for EM to help to integrate the existing and developing disease-based systems of care into a more comprehensive emergency care system.

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Recent advances in therapy for many time-critical illnesses including sepsis, stroke, and cardiac arrest are known to decrease morbidity and mortality. While the evidence for therapies such as tissue plasminogen activator (tPA), early goal-directed therapy, and therapeutic hypothermia is strong,<sup>1–4</sup> a nationwide implementation of these life-saving treatments has proven a considerable challenge. The statistics speak for themselves: 30% of patients with ST-segment elevation myocardial infarction (STEMI) receive neither fibrinolytic therapy nor percutaneous coronary intervention (PCI),<sup>5</sup> and as little as 3% of patients with acute stroke

receive tPA.<sup>6</sup> Regionalized networks of care, such as designated STEMI and stroke centers, are known to improve compliance with existing guidelines.<sup>7–9</sup>

The 2010 *Academic Emergency Medicine (AEM)* consensus conference “Beyond Regionalization” represents organized emergency medicine’s (EM’s) commitment to designing a 21st century emergency care system that maximizes use of existing therapies. Through these proceedings, we aim to move past the traditional model of prehospital regionalization and unidirectional flow of patient care between facilities and hope to transform the future organization of emergency care into integrated networks of care. Sepsis, cardiac arrest, STEMI, and stroke are alike in their need for urgent intervention, yet have widely disparate resource requirements, both cognitive and procedural. A one-size-fits-all approach will not be sufficient. New roles for system resources and personnel are needed for optimal delivery of care.

If EM is to take a leading role in this endeavor, as it should, it is critical that we actively involve and encourage participation by all components of the emergency care delivery system. Examining the lessons learned from existing regional networks of care, including those

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Panel discussants: Rifat Latifi, MD, Alice Jacobs, MD, Arthur Pancioli, MD, Joseph P. Ornato, MD, Brain A. Rosenfeld, MD, Marianne Gausche-Hill, MD, and Lewis S. Nelson, MD.

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long in existence, is a logical starting point. To that end, the organizers of *AEM's* consensus conference requested the participation of leaders from a diverse group of medical specialties or topic area experts, including surgery, stroke, cardiology, critical care, pediatrics, and medical toxicology. Their combined experience offers valuable insight into the development of regionalized networks. We asked that through a panel discussion they share with us lessons learned over the years, including key successes, barriers to effective and sustainable networks of care, and potential solutions. The following is a brief biography of each participant and a summary of their remarks.

### **EMERGENCY SURGERY AND TELEMEDICINE**

Dr. Rifat Latifi is a Professor of Clinical Surgery at the University of Arizona and the Director of Telemedicine for Trauma and Critical Care at University Medical Center (UMC) in Tucson, Arizona. His principal interests are in telemedicine through collaborations in underdeveloped countries and rural America and in the establishment of acute care surgery as a recognized surgical fellowship.

Dr. Latifi spoke about new paradigms in the management of acute surgical illness. While emergency surgery was traditionally the realm of general surgeons who regularly took call, the nationwide shortage of specialists has brought about the need for an emergency surgical specialist. Under the leadership of the American College of Surgeons Committee on Trauma (ACSCOT) and American Association of Surgery and Trauma (AAST), a new fellowship in emergency and critical care surgery has been developed to respond to this growing need. The curriculum, already in place at institutions such as the University of California San Francisco, University of Colorado in Denver, and the Shock Trauma Center in Baltimore, encompasses the skills now practiced by trauma surgeons, in addition to emergent neurosurgical and orthopedic procedures. Training in elective procedures including biliary surgery are also standard components of the curriculum. The continued expansion of such programs may alleviate a critical shortage of surgeons willing to provide these emergent procedures.

Dr. Latifi also spoke about the expanded use of telemedicine throughout the nation. He is the director of the Southern Arizona Telemedicine and Telepresence (SATT) program, a virtual interfacility network providing eight rural hospitals in Arizona with 24/7 access to trauma expertise at UMC through live audio and video communication. In addition, all ambulances in the greater Tucson area are connected to this network, to assist providers in the field with both emergent management and transport decision-making.

### **STEMI**

Dr. Alice Jacobs is a Professor of Medicine at Boston University School of Medicine and the Director of the Cardiac Catheterization Laboratory at Boston Medical Center. She is a past president of the American Heart Association (AHA), currently serves as Chair of the

ACC/AHA Task Force on Practice Guidelines, and was recently elected President of the Association of University Cardiologists. Her major research interest is in coronary revascularization strategies, and she is leading the AHA's *Mission: Lifeline*,<sup>10</sup> a national initiative to develop systems of care to increase the number of STEMI patients receiving prompt PCI.

As Dr. Jacobs explained, "the enthusiasm in providing regionalized STEMI networks is based upon the disconnect between our evidence-based, life-saving, guideline-recommended therapies and our inability to deliver these therapies to all patients throughout the country." Thirty percent of STEMI patients do not receive fibrinolytics or PCI,<sup>5</sup> and patients who do receive these therapies often do not receive them within the recommended time from presentation or symptom onset.<sup>11</sup> Effective regionalized models, including the Minneapolis Heart Institute, have successfully addressed this disconnect,<sup>7</sup> but to date are not present on a national level. Significant barriers remain in the management of STEMI, including public education (50% of patients with STEMI fail to activate emergency medical services (EMS) at all<sup>12</sup>) and emergency department (ED) crowding resulting in ambulance diversion. Patients with acute myocardial infarction are largely insured and profitable,<sup>13</sup> and hospital finances may play a role in the decision to transfer a patient to a PCI-capable facility. Additional barriers to effective management include lack of universal ECG monitoring available to EMS (especially in rural environments) and insufficient training in ECG interpretation among EMS providers. Activation of a PCI lab by EMS remains grossly under-utilized and linkage between EMS and hospital data is poor.

To address these challenges, the AHA's *Mission: Lifeline* was created to improve the quality of care and outcomes for STEMI patients and to improve the healthcare system readiness and response to STEMI. The initial implementation plan consisted of the evaluation of existing STEMI model systems, performance of EMS assessment, establishment of local initiatives, and exploration of national STEMI certification. To date, over 400 STEMI systems are registered with *Mission: Lifeline*, covering 47% of the U.S. population. *Mission: Lifeline* continues to work on both a community and national level to address these barriers.

### **STROKE**

Dr. Arthur Pancioli is a Professor and Executive Vice Chairman of the Department of Emergency Medicine at the University of Cincinnati College of Medicine. He is the co-director of the Greater Cincinnati/Northern Kentucky Stroke team, which provides acute stroke treatment consultation for all of the 15 hospitals in the region. Dr. Pancioli is the principal investigator on the "Combined Approach to Lysis Utilizing Eptifibatid and rt-PA-Enhanced Regimen" (CLEAR-ER) stroke trial, an NINDS-funded, multicenter trial evaluating the safety of the combination of a fibrinolytic and GPIIb/IIIa receptor antagonist in the setting of acute stroke. He is also the network operations manager for the Neurological Emergencies Treatment Trial (NETT) network.

As Dr. Pancioli explained, “stroke is the perfect disease process” amenable to regionalized systems of care for three reasons. First, the incidence of acute stroke in the United States is profound, with 795,000 new cases occurring annually.<sup>14</sup> It is the third leading cause of death in the United States and remains a significant cause of morbidity.<sup>15</sup> Second, management of acute stroke requires a multidisciplinary approach and coordination of care between EMS, ED providers, and stroke specialists. Third, management of acute stroke continues to evolve and promising new therapies are in development.

Dr. Pancioli believes that one of the greatest barriers to effective regionalized systems of care is “incentive malalignment.” As stated previously, STEMI patients are largely well insured and profitable. Non-PCI hospitals therefore have potential financial disincentives to transferring STEMI patients to PCI centers. This can lead to a triage system “based on economics” rather than maximized patient outcomes. The Greater Cincinnati/Northern Kentucky Stroke Network eliminates this malalignment, providing 24/7 specialty consultation to every hospital in the region, eliminating need for transfer and competition between facilities. The acute care team consists of emergency physicians, vascular neurologists, neurointensivists, and fellowship trainees providing on-site specialty consultation to 15 area hospitals and additional telephone consultation to distant facilities. This is a shift from the paradigm of bringing the patient to the doctor. Rather, it brings the doctor to the patient. Explains Dr. Pancioli, “The answer isn’t always centralization. It’s the right care for the right patient in the right time.”

## CARDIAC ARREST

Dr. Joseph Ornato is Professor and Chairman of the Department of Emergency Medicine at Virginia Commonwealth UMC/Medical College of Virginia in Richmond. He also serves as Medical Director of the Richmond Ambulance Authority and the Prehospital Paramedic System serving the City of Richmond and is an active researcher in the field of cardiopulmonary resuscitation. Dr. Ornato serves as the American editor of the journal *Resuscitation* and is on the editorial board of the *American Journal of Emergency Medicine*. He is the past Chairman of the AHA’s National Emergency Cardiovascular Care Committee and its Advanced Cardiac Life Support Subcommittee.

While every hospital in the United States must be prepared to manage cardiac arrest, optimized therapies, including therapeutic hypothermia (TH), are resource-intensive, and “there are not enough patients at every hospital to justify that expense,” said Dr. Ornato. Essential elements of an optimal regional system of care for out-of-hospital cardiac arrest include an educated public and a high-performance EMS system that rapidly initiates basic life support and advanced cardiac life support. For patients with return of spontaneous circulation (ROSC), goal-directed therapy should be provided by an experienced multidisciplinary care team to induce early TH and facilitate transfer to a limited number of regionalized post-resuscitation centers.

The Advanced Resuscitation Cooling Therapeutics Intensive Care (ARCTIC) center in Richmond has implemented these essential elements of optimal post-cardiac arrest care. EMS units are equipped with cooled normal saline, and they initiate cooling during resuscitation, which has been associated with an increase in the rate of ROSC from 25% to more than 50% in patients with out-of-hospital ventricular fibrillation arrest. Network hospitals are trained in TH induction, and patients deemed appropriate for TH are transferred to Virginia Commonwealth UMC. However, evidence suggests that TH is only the first step; simultaneous goal-directed intensive care further improves outcomes. Continuous electroencephalogram monitoring is routinely provided, as is early PCI when needed. A 72-hour moratorium on care withdrawal is standardized and detailed neuropsychiatric testing is provided for all survivors. Survival to hospital discharge in this system is well above the national average, with 72% of patients presenting with an initial rhythm of ventricular fibrillation surviving to discharge.

## CRITICAL CARE MEDICINE

Dr. Brian A. Rosenfeld is a nationally recognized intensive care specialist who pioneered and developed the concept of remote intensive care unit (ICU) management. He co-founded Philips VISICU Inc. in 1998 and presently serves as Philips Patient Monitoring & Informatics (PMI) Chief Medical Officer. In this role, he is responsible for devising the strategic direction of telehealth within PMI. Prior to founding VISICU, Dr. Rosenfeld was Associate Professor of Anesthesiology and Critical Care Medicine at the Johns Hopkins University School of Medicine.

The shortage of critical care physicians, particularly in rural areas, remains a significant problem. Since leaving academia in 1998 and co-founding VISICU Inc., 43 eICU networks have been established throughout the nation, overseeing approximately 10% of all ICU beds nationwide. This “hub-and-spokes” model is now expanding into many EDs. For example, critical care physicians located at a distant eICU center can now facilitate transfer from the ED in a smaller community hospital to a regional tertiary care facility if necessary. Expert consultation need not be limited by geographic boundaries when using a telemedicine network. “Regionalization doesn’t necessarily have to be geographically located,” explained Dr. Rosenfeld, “it could be developed around integrated delivery networks.”

## PEDIATRIC EMERGENCY CARE

Dr. Gausche-Hill is the director of the EMS and Pediatric Emergency Medicine Fellowships at Harbor-UCLA Medical Center. She is nationally known for her leadership and research in the field of pediatric EM and EMS. She served on the Institute of Medicine’s (IOM’s) committee examining the Future of Emergency Care in the United States Healthcare System, and in 2008, she was named one of the Heroes of Emergency Medicine by ACEP.

The 2006 IOM Report “Emergency Care for Children: Growing Pains”<sup>16</sup> concluded that pediatric emergency

care is uneven in the United States. Fifty percent of all U.S. EDs see fewer than 10 pediatric patients per day.<sup>17</sup> There are currently 226 children's hospitals and 170 trauma centers with pediatric capabilities in the United States. In many instances, these hospitals have become the de facto referral centers for smaller hospitals and community EDs, where resources for pediatric care are few—a result of the “hub-and-spokes” model. To a degree, efforts to regionalize pediatric emergency care are in place. For example, the Emergency Department Approved for Pediatrics (EDAP) model was first established in Los Angeles County in 1985, and this year celebrates its 25th year. An EDAP must be in compliance with guidelines set by the Department of Health Services and are verified by local EMS systems. Only those hospitals meeting requirements as an EDAP in Los Angeles County may receive children by EMS. Illinois, Oklahoma, and Tennessee have adopted similar models.

A unique challenge in the development of regionalized networks of pediatric emergency care is that “parents tend to transport based on geography, not local capabilities,” said Dr. Gausche-Hill. Additionally, children are much more likely to be transported directly by their parents, rather than using the EMS system. A drawback to regionalization of pediatric care is the potential to siphon away pediatric patients from EDs that see few children to begin with. This, in turn, could leave emergency physicians practicing in these EDs with deteriorating skills specific to the pediatric population. It is critical that every ED maintain a minimum set of pediatric skills and resources. Telemedicine may offer a bridge to those facilities with sparse pediatric resources.

## TOXICOLOGY

Dr. Lewis Nelson is an Associate Professor of Emergency Medicine at NYU School of Medicine. He is the Director of the Fellowship in Medical Toxicology at NYU and the Associate Medical Director of the New York City Poison Control Center. Dr. Nelson is the incoming president of the American College of Medical Toxicology. He is an editor of *Goldfrank's Toxicologic Emergencies*,<sup>18</sup> recently released in the 9th edition.

Poison control centers remain a highly utilized and underappreciated resource available to the general public and medical providers. There are 300,000 hospitalizations and 30,000 deaths each year as a result of toxic exposures, amounting to \$12.6 billion in yearly costs.<sup>19</sup> However, poison control centers provide an invaluable public service while also saving the medical system money. Because 70% of calls to poison centers by the general public are managed simply over the phone, it is estimated that for every \$1 spent on poison control centers, \$7 dollars are saved in medical costs.<sup>20</sup> Medical toxicology consultative services have also been shown to decrease patient length of stay, decrease laboratory testing, and result in more selective antidote use.<sup>21</sup>

Because toxicologic emergency consultations are typically cognitive in nature, patient transport to a poison center is unnecessary. A regionalized system of care through telephone consultation was thus established with relative ease compared to other time-critical disease processes. Poison control centers are a loosely

woven network with a disparate and fragmented source of funding. Financial solvency for these centers remains problematic, and many are perpetually on the verge of collapse. The IOM has advocated for federal funding for poison control centers,<sup>19</sup> yet funds continue to dwindle. “Medical toxicology really sprung out of emergency medicine and for the medical needs for poison control centers,” explained Dr. Nelson, “we suffer from that same funding problem because when we developed we really didn't have a mechanism for revenue generation.” As regionalization efforts continue for other disease processes, Dr. Nelson emphasized that it is critical to determine sources of revenue to maintain financial solvency.

## CONCLUSIONS

The oft-cited 2006 IOM report *At the Breaking Point* criticized existing components of the emergency care system for working in “silos,” adding that, “the main impediment appears to be entrenched interests and a lack of vision to motivate change in the current system.”<sup>22</sup> STEMI, acute stroke, sepsis, cardiac arrest, and acute poisoning are a diverse group of time-sensitive illnesses that all have one aspect in common: they all come through the emergency department. Organized emergency medicine, only three decades after becoming a recognized specialty, is now poised to become a leader in shaping the superstructure of the medical delivery system.

To accomplish the IOM's goal of creating a “coordinated, regionalized, and accountable system,” we must actively engage and encourage participation of all the requisite components of that system, breaking out of our own silo. Our objective in calling this consensus conference was to bring the emergency care delivery system together so that we might begin to think creatively about ways to maximize use of effective therapies through regional networks of care. We believe that emerging technologies such as telemedicine will play a significant role in redesigning and integrating emergency care. We aim to shift the paradigm from the previous focus of bringing the patient to the doctor, in favor of bringing the doctor to the patient, at the right place, at the right time.

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