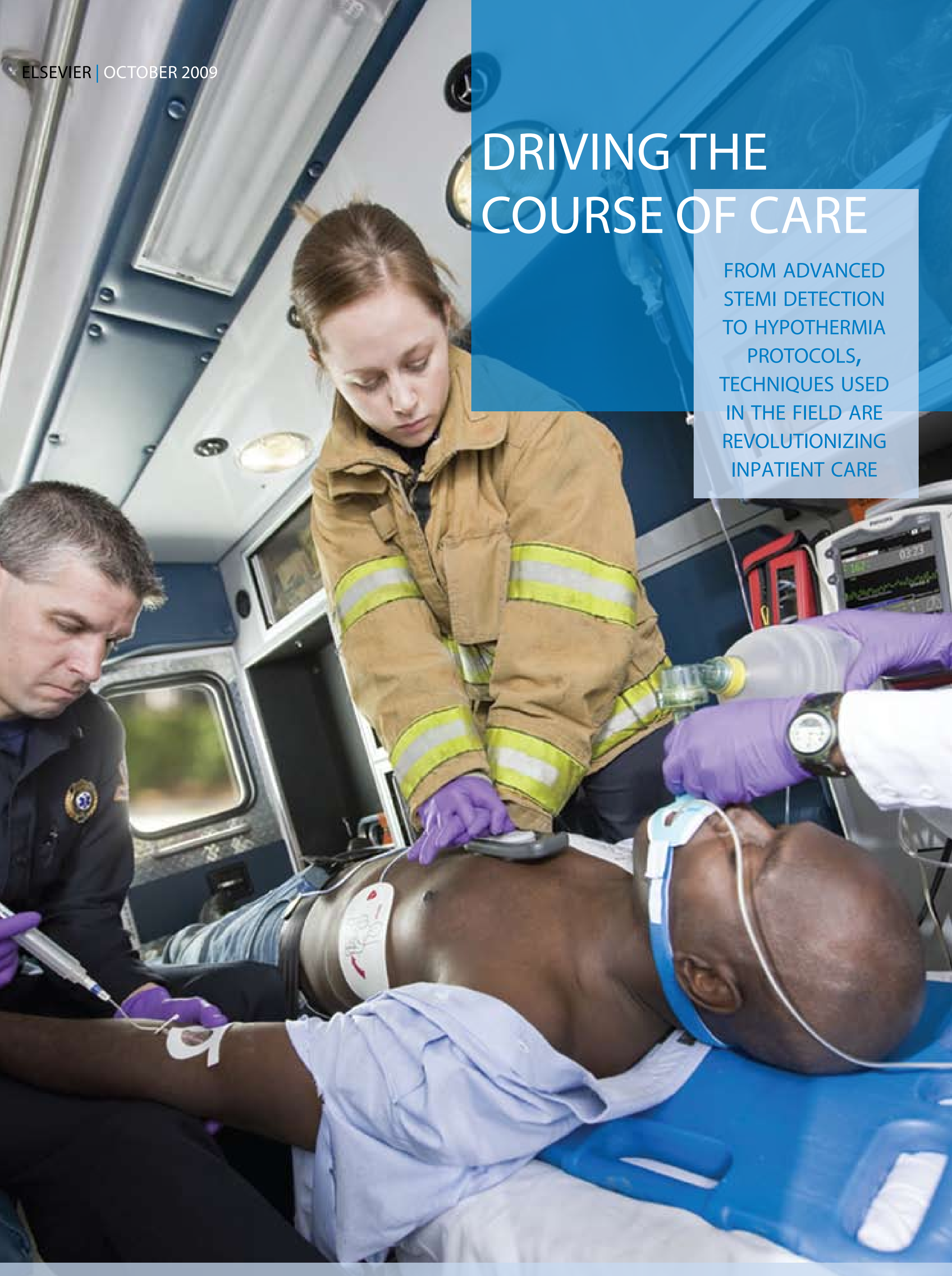
ELSEVIER | OCTOBER 2009

DRIVING THE COURSE OF CARE

FROM ADVANCED STEMI DETECTION TO HYPOTHERMIA PROTOCOLS, TECHNIQUES USED IN THE FIELD ARE REVOLUTIONIZING INPATIENT CARE



The Conscience of EMS JEMS JOURNAL OF EMERGENCY MEDICAL SERVICES

PHILIPS

An exclusive supplement to JEMS sponsored by Philips Healthcare

TABLE OF CONTENTS

Vice President/Publisher
JEFF BEREND
Editorial Director
A.J. HEIGHTMAN, MPA, EMT-P
Managing Editor
SHANNON PIEPER
Art Director
LILIANA ESTEP
Advertising Director
JUDI LEIDIGER
Cover Photo and all photos unless otherwise indicated COURTESY PHILIPS HEALTHCARE

Disclosure of Author Relationships: Contributing authors have been asked to disclose any relationships they may have with commercial supporters of this supplement or with companies that may have relevance to the content of the supplement. Such disclosure at the end of each article is intended to provide readers with sufficient information to evaluate whether any material in the supplement has been influenced by the writer's relationship(s) or financial interests with said companies.

To view this supplement online, go to www.jems.com/EMSdrivesCare.

Driving the Course of Care is a supplement sponsored by Philips Healthcare and published by Elsevier Public Safety, 525 B Street, Ste. 1900, San Diego, CA 92101-4495; 800/266-5367 (Fed ID # 13-1958712). Copyright 2009 Elsevier Inc. No material may be reproduced or uploaded on computer network services without the express permission of the publisher. To subscribe to an Elsevier publication, visit www.jems.com. Advertising rates are available on request. Contact Elsevier Public Safety, Advertising Department, 525 B Street, Ste. 1900, San Diego, CA 92101-4495; 800/266-5367.

DRIVING CLINICAL INNOVATION THROUGH EMS

By Paul E. Pepe, MD, MPH & A.J. Heightman, MPA, EMT-P


Paul E. Pepe, MD


A.J. Heightman

In the early years of EMS, the only advanced assessment and clinical items crews used were BP cuffs, three-lead ECG units, manual defibrillation and, in some systems, rotating tourniquets for congestive heart failure cases. Telemetry was primitive and often inaccurate, making Emergency Department (ED) physicians reluctant to order advanced treatment until they saw the patient.

Ventilators, pleural decompression, crics, CPAP and intraosseous infusion for adult patients were rarely used or performed in the field; in fact, many hospitals called IV or surgical team personnel to the ED to start difficult IVs or subclavian lines, or to perform crics or needle decompressions. Respiratory department personnel were, and still are in some areas, called to the ED to place patients on ventilators and CPAP.

But with new technological advances and high-quality training, over time trust developed in EMT and paramedic capabilities. And improvements in training and medical direction—in both prehospital and hospital systems—has allowed technology and advanced medical treatment to rapidly expand in the field, hospitals and EDs. In many instances, innovative prehospital systems and their medical directors are on the front lines leading the charge.

Today, EMS is equipped with more advanced technology to help speed decision-making and help hospitals better prepare for patient treatment prior to arrival. Now when EMS arrives on scene, they connect patients to cardiac monitors that measure and analyze a multitude of parameters (12-lead ECG, S_pO_2, CO_2, tidal volume, temperature, CO levels and much more), and they send real-time vital-sign parameters and trends to the receiving hospital. In many cases, EMS personnel also send the transmissions simultaneously to the cath lab, a cardiologist, the trauma team or their medical director's mobile phone.

Most ALS systems, and many BLS systems, are now starting CPAP early in the field, quickly reversing the patient's frightening sense of drowning from congestive heart failure (CHF), greatly reducing the number of patients who need to be intubated, and ultimately reducing the number of patients who develop ventilator-associated pneumonia (VAP) and die unnecessarily.

More importantly, by driving the technological care of CHF patients in the field with adult IO and CPAP, many hospitals have begun to place IO devices and CPAP units in their EDs, breaking from the traditional processes of delivering equipment to the ED to care for patients.

And, resuscitation is moving rapidly from being treated as an individual effort to a carefully orchestrated set of steps, including an effective biphasic defibrillation shock, high-quality CPR and therapeutic hypothermia. When cooling is initiated in the field, evidence shows that the best results occur when the receiving hospital continues hypothermia for 24–48 hours. As with stroke and trauma, the emergence of the Cardiac Arrest Center may be upon us largely driven by the capability of EMS to achieve return of spontaneous circulation (ROSC) more frequently and begin cooling the patient before hospital arrival.

This JEMS supplement presents new ways in which EMS is leading the pack in offering advanced monitoring and medical care in the field and driving additional advancements to their receiving EDs. Advanced monitoring and diagnostics, coupled with Bluetooth technology, computer-aided dispatch and electronic patient care record systems, will mean earlier field recognition of conditions and trends, and earlier reporting and care in receiving hospitals, both of which will greatly benefit our patients.

Read it carefully. These advances will place the future of emergency patient care in your hands.

Paul E. Pepe, MD, MPH, FACEP, MACP, FCCP, FCCM, is a professor of Surgery, Medicine, Pediatrics and Public Health and chair of Emergency Medicine at the University of Texas Southwestern Medical Center and The Parkland Health and Hospital System, Dallas. He also serves as the City of Dallas director of medical emergency services for Public Safety, Public Health and Homeland Security, and as medical director of the Dallas Metropolitan Medical Response System (MMRS) for Counter-Terrorism and Disaster Mitigation and medical director of the Dallas Metropolitan Bio Tel (9-1-1 EMS) System. Dr. Pepe also coordinates the U.S. Metropolitan Municipalities EMS Medical Directors ("Eagles") group.

A.J. Heightman, MPA, EMT-P, is editor-in-chief of JEMS and editorial director for Elsevier Public Safety. He has served as the EMS director for the six-county eastern Pennsylvania EMS region and as operations director for Cetronia Ambulance in Allentown, Pa.

THE MOST IMPORTANT TEST

By Mohamud Daya, MD, MS

RECENT ENHANCEMENTS MADE TO PHILIPS DXL ECG ALGORITHM EXPEDITE DETECTION OF ACUTE ISCHEMIA, AMI & STEMI

STEMI patients are ideal candidates for time-critical interventions, and they are now often identified in the field.

The clinical presentation of acute myocardial infarction (AMI) varies greatly among individuals and requires consideration of clinical findings, electrocardiographic (ECG) features and the presence of myocardial cell death.[1] Of these, the ECG is most important, because it can quickly identify ST elevation myocardial infarction (STEMI, a subset of AMI). This is especially important since STEMI patients are ideal candidates for time-critical interventions, such as coronary artery catheterization or fibrinolytic therapy.

Over the past several years, numerous EMS systems have enhanced their prehospital diagnostic and treatment considerations for AMI through the use of ECG technology. The field ECG's ability to aid in the quick diagnosis of STEMI has also led to the development of dedicated systems of care, including transport to specialized STEMI receiving centers (STEMI-RC).[2] Once acquired, the 12-lead ECG can be interpreted by physician, paramedic or STEMI-RC, depending on the technology and sophistication of the EMS system.[2]

Recently, the American Heart Association (AHA), in conjunction with the American College of Cardiology (ACC) and the Heart Rhythm Society (HRS), published a series of scientific statements on the standardization and interpretation of the ECG. The last of these focused on recommendations for improved detection of acute ischemia and AMI.[3] These enhancements have been incorporated into the Philips DXL ECG algorithm and the HeartStart MRx monitor/defibrillator.

The following sections highlight the enhanced functionality of the Philips DXL algorthim that should be valuable to EMS providers.

The STEMI Algorithm

Until recently, the ECG standards for ST-segment elevation required J-point elevation greater than 0.2 mV (2 mm with standard calibration) in leads V1–V3 and greater than 0.1 mV (1 mm) in all other leads. These criteria were established to reduce the false detection of ST elevation associated with early repolarization in young males. As a result, the sensitivity of computerized ECG interpretation has been found to be lower for anterior STEMI than for inferior STEMI.[4]

The new AHA/ACC/HRS statements recommend that the threshold value for J-point elevation now be adjusted for age and gender to improve detection of anterior AMI.[3] Specifically, the new criteria recommend a J-point threshold in V2 and V3 of 0.2 mV in men 40 years of age and older, 0.25 mV for men younger than 40 and 0.15 mV for women of all ages. In all other leads, the J-point elevation threshold is 0.1 mV for all ages regardless of gender. The DXL algorithm incorporates these new criteria to improve STEMI detection in women and reduce false alarms with young men.

Because right-ventricular AMIs often go unrecognized in the presence of an inferior or posterior AMI, the DXL algorithm has also been programmed per the new recommendations to suggest consideration of right-sided chest leads (V3R, V4R) in the appropriate setting (see Figure 1, p. 5).

The potential value of a right-sided chest lead recommendation is illustrated by a recent case within our EMS system. Crews responded to a 73-year-old male complaining of nausea and chest pain. He was pale and diaphoretic with an absent radial pulse and a heart rate of 58. His 12-lead ECG showed ST elevation in lead II and aVF, along with ST depression in leads I, aVL and V1–V3. The crew established an IV, placed the patient in the Trendelenburg position, gave him aspirin and a dopamine infusion and rapidly transported him to a STEMI-RC. Had the computerized interpretation recommended a right-sided ECG, the diagnosis of right-ventricular AMI may have prompted the crews to consider a fluid bolus before turning to dopamine.

STEMI-Culprit Artery Identification

Another AHA/ACC/HRS recommendation is that algorithms identify the occluded artery and the site of occlusion within that artery, if possible.[3] The DXL algorithm meets this objective by offering STEMI-Culprit Artery identification. Culprit arteries identified by the algorithm include the left anterior descending (LAD) artery, the right coronary artery (RCA), the left circumflex (LCx) and the left main or multi-vessel disease (LM/MVD).

Identification of the culprit artery helps direct therapy in the presence of multi-vessel disease and can also help in the interpretation of clinical features. For example, occlusion of the RCA can be associated with heart blocks, because both the SA and AV nodes are often supplied by this artery.

Similarly, a large anterior infarction associated with an occluded LAD and hypotension indicates cardiogenic shock. Such patients don't benefit from thrombolytic therapy and must be transported rapidly to a STEMI-RC. Fluid therapy in these instances should also be limited in favor of earlier inotropic support to avoid pulmonary edema.

Critical Value Statements

The Philips DXL ECG algorithm has incorporated four critical value statements designed to alert providers to ECG features that require immediate attention: Acute MI, Acute Ischemia, Extreme Tachycardia and Complete Heart Block.

The Acute MI statements were introduced to allow for more rapid detection of STEMI as well as to reduce false-positive STEMI alerts. The AMI statement was triggered primarily by the presence of ST segment elevation combined with reciprocal ST depression (see Figure 1).

Acute global myocardial ischemia is defined as a non-ST elevation myocardial infarction (NSTEMI), which presents with ST depression in multiple leads along with ST elevation in aVR. It's frequently associated with severe left main (LM) coronary artery occlusion or high grade multi-vessel disease (MVD).[5]

Early identification of LM/MVD is important because patients have a high risk of complications, such as cardiac arrest and pump failure. These patients are also more likely to require coronary artery bypass grafting (CABG).[5] The Acute Ischemia statement, combined with the LM/MVD STEMI-Culprit Artery identification, now allows for early detection of this condition.

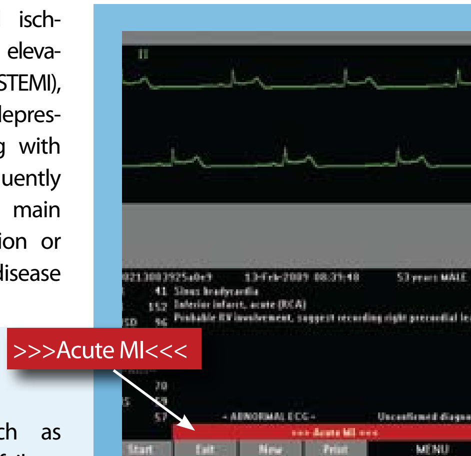


Figure 1: The DXL ECG algorithm has been programmed per the new recommendations to show right-sided chest leads (V3R, V4R), culprit artery identification and the Acute MI statement. These enhancements expedite detection of acute ischemia, AMI and STEMI.

Other Enhancements

The DXL ECG algorithm also includes several other enhancements, such as more sensitive and specific detection of atrial fibrillation and more sensitive detection of pacemakers (atrial, ventricular and dual).

Summary

The 12-lead ECG remains the most important initial test for the diagnosis of AMI. Enhancements in the Philips DXL ECG algorithm have improved its ability to detect STEMI rapidly; however, the ECG cannot be interpreted in isolation. Many other conditions can still mimic STEMI due to deviation of ST segments, including acute pericarditis, early repolarization, hyperkalemia, left ventricular hypertrophy and bundle branch blocks.[6] The ECG should always be interpreted in conjunction with clinical findings and, where available, prior tracings.

Mohamud Daya, MD, MS, is an associate professor in the Department of Emergency Medicine at the Oregon Health & Science University. He is also the medical director for Tualatin Valley Fire & Rescue and Forest Grove Fire & Rescue as well as the Washington County Consolidated Communications Agency in Oregon. He can be contacted at dayam@ohsu.edu.

Disclosure: The author has served as a consultant for the Cardiac Care division of Philips Healthcare.

References

1. Senter S, Francis GS: "A new, precise definition of acute myocardial infarction." Cleveland Clinic Journal of Medicine. 76(3):159–166, 2009.
2. Ting HH, Krumholz HM, Bradley EH, et al: "Implementation and integration of prehospital ECGs into systems of care for acute coronary syndromes." Circulation. 118(10):1066–1079, 2008.
3. Wagner GS, Macfarlane P, Wellens H, et al: "AHA/ACCF/HRS recommendations for the standardization and interpretation of the electrocardiogram: Part VI: Acute ischemia/infarction." Circulation. 119(10):e262–270, 2009.
4. Kudenchuk PK, Ho MT, Weaver WD et al. "Accuracy of computer-interpreted electrocardiography in selecting patients for thrombolytic therapy." Journal of the American College of Cardiology. 17:1486–1491, 1991.
5. Kosuge M, Kimura K, Ishikawa T, et al: "Predictors of left main or three-vessel disease in patients who have acute coronary syndromes with non-ST-segment elevation." American Journal of Cardiology. 95(11):1366–1369, 2005.
6. Wang K, Asinger RW, Marriott HJ: "ST-segment elevation in conditions other than acute myocardial infarction." New England Journal of Medicine. 349(22):2128–2135, 2003.

REGIONALIZED CARDIAC ARREST CARE

By John Freese, MD

HOW FDNY IMPLEMENTED A REGIONAL HYPOTHERMIA PROTOCOL FOR CARDIAC ARREST CARE

Recent studies have highlighted the benefits of therapeutic hypothermia for cardiac arrest care. FDNY successfully incorporated therapeutic hypothermia as a regional standard for post-resuscitation management.

Several systems have successfully incorporated therapeutic hypothermia into their resuscitation efforts as part of many significant efforts made in recent years to improve cardiac arrest outcomes. But across the country, the use of hypothermia has not yet become an accepted standard; regionalization of cardiac arrest management remains the subject of discussions in the literature.[1-5]

In 2008, the New York City 9-1-1 System provided nearly 1.4 million EMS responses, including 7,357 cardiac arrest patients for whom resuscitation was attempted. As a result of advancements in cardiac arrest care, these patients were more likely to achieve return of spontaneous circulation (ROSC) than ever before, including a 75% increase in ROSC among witnessed arrests of cardiac etiology.

But the lack of a regional approach to cardiac arrest management meant that patients were transported to all 68 hospitals within the five boroughs of New York City, few of which were actively utilizing hypothermia, and even fewer of which had protocols recommending its use for a wide range of patients.

From Need to Reality

In late 2007, FDNY led discussions to facilitate the development of a system for regionalized cardiac arrest care. These initial meetings were inclusive, allowing the participation of any interested hospital with the goal of ensuring the incorporation of therapeutic hypothermia as a regional standard for post-resuscitation management. Hospitals interested in becoming Cardiac Arrest Centers needed to meet the following qualifications:

- An ICU to which patients may be admitted;
- The ability to have the emergency medicine and critical care departments work together with EMS to ensure a continuum of care within the hospital;
- The ability to achieve target temperature (32–34ºC) within four hours of patient arrival; and
- An agreement to participate with FDNY in a bidirectional sharing of patient data.

Over the next 12 months, FDNY joined with NYC Health and Hospitals Corporation and the Greater New York Hospital Association in stakeholder meetings, sent written communications to hospital administrations, received IRB approval for oversight of the regional data registry, and worked with local and international experts to develop a regional hypothermia protocol.

Recognizing the varying needs of the hospitals in the region, the process allowed for entry into or self-initiated withdrawal from the program at any time after its initiation. This allowed facilities to develop the internal protocols, educational programs and inter-departmental agreements necessary to ensure high-quality patient care with respect to hypothermia.

Today, we have 60 approved 9-1-1-receiving hospitals within the five boroughs. These include 19 Cardiac Arrest Centers/PCI facilities, 19 Cardiac Arrest Centers, four PCI facilities and 18 hospitals that are neither Cardiac Arrest Centers nor PCI facilities.

Successes & Challenges

Although we're still in the midst of a formal analysis of the data from the first six months of this program, a number of items highlight the project's early successes:

- More than 1,000 patients have already been transported to Cardiac Arrest Centers after achieving ROSC in the prehospital setting. These patients ranged from 18–105 years; some presented in VF and others in non-shockable rhythms, and some experienced arrests not of cardiac etiology.
- Of those known to have survived to hospital admission, nearly 40% qualified for and received therapeutic hypothermia based on the regional protocol criteria including VF and non-VF arrests, cardiac and non-cardiac etiologies, and patients within a wide age range (25–88 years).
- It would be premature to discuss survival data at this stage; a formal release of this data is expected

in a few weeks. What can be said is that we have already witnessed neurologically intact survivors from VF and non-VF rhythms, as well as patients up to age 83 and those with arrests of non-cardiac etiology.

As with any new program, we also face challenges; one of the most significant results from our state's public reporting structure, which documents mortality statistics of individual cardiologists. Performing even a few additional procedures for patients who have a high baseline mortality rate (e.g., post-arrest patients, even with demonstrated ST-segment elevation) can give the false appearance of a high mortality rate for a particular physician or institution. As a result, we continue to push for the adoption of exemptions in the reporting.

At present, adult patients who achieve ROSC after non-traumatic cardiac arrests qualify for transport to a Cardiac Arrest Center. As we move toward the next phase of this project and initiate hypothermia during prehospital resuscitations, we will face a number of additional challenges: We will need to address the question of obligated transport of all arrests, irrespective of ROSC. We will work with hospitals to address the issue of discontinuing hypothermia despite survival to admission for select patients. And to that end, as our registry begins to identify patients who are universally excluded from hypothermia treatment in this present phase (DNR, dementia, severe comorbidities), we may need to develop more selective treatment criteria so as not to initiate hypothermia that Cardiac Arrest Centers would not continue.

Finally, studies in other systems have suggested a volume-outcome relationship among facilities that care for a large number of post-resuscitation cases.[6] Put simply, facilities that receive and manage large numbers of post-arrest patients have better outcomes among those patients. So in the future, we may need to reassess our attempt to be inclusive of all hospitals interested in participating and ensure that hospitals meet a minimum case volume to participate.

Recommendations

Our experience demonstrates that efforts to regionalize cardiac arrest care, even in a large system, can be successfully led from within the EMS community. Regions considering such an approach to cardiac arrest management should consider our lessons learned:

- There are significant political and economic implications in developing such a system that must be recognized. But as an effort to ensure quality care, it's critical to keep the patient at the forefront of the discussion at all times.
- Involve both clinicians and hospital administrators (CEOs, CMOs) in the process. Although we initially focused on the emergency medicine, cardiology and critical care leaders, we soon realized that their ability to speak for a hospital or system was often lacking.
- Ensure that facilities not already providing hypothermia are aware of how important their nursing staff is to obtaining success.
- Maintain two-way communication with participating agencies. Frequent data sharing, individual meetings, joint oversight committees and regional reviews are essential to maintaining participation.

Philips InnerCool surface and endovascular temperature management systems can rapidly induce therapeutic hypothermia in the ED and ICU, continuing cooling that was initiated prehospital.

Conclusion

The use of therapeutic hypothermia in post-resuscitation management and the regionalization of cardiac arrest care have been developed in only a few select cities across the nation. The NYC Project Hypothermia is our effort to provide such care to city residents and visitors. As the project progresses, we look forward to reporting on additional successes and lessons learned, and we encourage other regions to consider developing a system to ensure this level of care for their patients.

John Freese, MD, serves as FDNY's medical director of training and on-line medical control, as well as director of prehospital research. He is the principal investigator for NYC Project Hypothermia, and he maintains an active clinical practice with the Department of Emergency Medicine at St. Vincent's Hospital, a Level I trauma center in lower Manhattan.

Disclosure: The author has reported receiving honoraria and/or research support, either directly or indirectly, from the sponsor of this supplement. FDNY receives grant funding from Philips Healthcare for other research for which Dr. Freese is also the principal investigator.

References

1. Merchant RM, Soar J, Skrifvars MB, et al: "Therapeutic hypothermia utilization among physicians after resuscitation from cardiac arrest." Critical Care Medicine. 34(7):1935–1940, 2006.
2. Kahn JM, Branas CC, Schwab CW, et al: "Regionalization of medical critical care: What can we learn from the trauma experience?" Critical Care Medicine. 36(11):3085–3088, 2008.
3. Seder D, Scholl M: "Regionalization of cardiac arrest care." Critical Care Medicine. 37(4):1534, 2009.
4. Kleinman ME: "Regionalization of critical care: Not just for kids." Critical Care Medicine. 37(7):2303–2304, 2009.
5. Kahn JM, Asch RJ, Iwashyna TJ, et al: "Physician attitudes toward regionalization of adult critical care: A national survey." Critical Care Medicine. 37(7):2149–2154, 2009.
6. Carr BG, Kahn JM, Merchant RM, et al. "Inter-hospital variability in post-cardiac arrest mortality." Resuscitation. 80(1):30–34, 2009.

THE ELECTRONIC CROSSROADS

By Raymond L. Fowler, MD, FACEP

OPPORTUNITIES & CHALLENGES IN MEDICAL DATA MANAGEMENT

Photo Courtney McCain

The evacuees who gathered in Houston following Hurricane Katrina brought to light the critical need for ePCR systems that can communicate across agencies and institutions.

It was a dark and stormy night. One of the largest hurricanes in recorded history curved through the Gulf of Mexico toward southern states terrified and cowering at its approach, and crashed into Louisiana and Mississippi on Aug. 29, 2005, evoking a blackout of agonizing proportions.

New Orleans was submerged, thousands required rescue from the floods, and an untold number were drowned in the raging torrents brought by the storm. On the Thursday after the storm we began to hear, "The buses are coming." We were told to expect as many as 200 or more buses, each with 50 or more people rescued from New Orleans on board, some within hours.

Knowing we were already exceeding capacity at Reunion Arena, Dallas Fire Rescue and EMS medical direction expanded operations into the 140,000-square-foot parking lot beneath the Dallas Convention Center, where we built a home for nearly 2,000 people, with thousands of inflatable mattresses and various support services. And, with 24 hours to prepare, we crafted a medical operation that would ultimately see some 10,000+ patients from the 40,000+ evacuees who came to Dallas County from Hurricane Katrina and later from Rita. Indeed, the medical surge facility we built played a critical role in protecting local hospitals from being overwhelmed.

Why present a painful recollection of this disaster in an article about data management? Because at the Katrina Evacuee Center we found ourselves nearly overwhelmed by the new and ongoing medical needs of our guests from the coast: hypertension, heart disease, pulmonary illnesses, seizures off meds, OB/GYN conditions and advanced pregnancies, acute diseases superimposed upon chronic illnesses and, as important as any, the vast mental health needs of an urban population torn from its roots. Short of the often empty bottles of medications brought in their hands—often stained by Mississippi flood waters—we knew nothing of the medical history of most of these patients.

The need for a large personal health-care database became evident when, almost a week after the storm, a national pharmacy chain set up a formidable dispensary in a double-wide trailer in the entryway to the Convention Center. The pharmacy chain maintained a strong presence in Louisiana, and its databanks teemed with prescription health records of thousands of our evacuees. In the first full day of clinical operation at the Convention Center, we saw more than 1,100 patients in 24 hours, and this electronic database made our jobs a little easier and safer. But thousands of other patients weren't in the database. Their paper records and complete medical histories were "water logged."

Not long after that episode, I took a break, cashed in some frequent flier miles and went to Italy. I stopped in Florence for a snack at a small café and at the end of the meal handed my credit card to the server. She whipped the card through a neat little wireless handheld checkout machine. In 10 seconds the machine had copied the card information, communicated with its local server, searched the database of the credit card company, approved the transaction and rolled out a receipt for me to sign. I couldn't help but reflect that if we can be connected across the world from a financial data flow perspective, how is it that 10,000 evacuees from an adjoining state came mostly as absolute strangers from a medical data perspective? What an embarrassment—but also, what an opportunity!

Data 'R Us

Whether it's global credit card purchases, driver's licenses, criminal records or insurance policies, personal identification information surrounds us all in a veritable electron cloud.

EMS data flow is no exception. Nearly left behind in the history of medicine are handwritten patient care reports (PCRs). The average state of EMS systems today is an electronic data recording and management system that provides standard format data points to local servers that receive the data. Many state EMS agencies now require local EMS agencies to upload data points relative to clinical care for various public health purposes.

The 21st century saw the completion of the first national data-collecting standard for EMS: the National EMS Information System (NEMSIS), which brings together, publishes and supports a rigorous data-collection and management system for EMS. With that momentous achievement—and from an EMS systems administrative perspective it was indeed phenomenal—a road map appeared that would galvanize an industry into new ways of communicating.

Importance of Medical Data in EMS Systems

How could such an effort bring benefit to a local EMS system? A noteworthy example can be found in the Dallas Area BioTel EMS System. In Dallas County, a federation of cities was crafted 35 years ago; today, that federation is called the BioTel EMS System and comprises 17 EMS agencies ranging in size from 700+ paid paramedics responding in 65 vehicles to an agency that operates a single ambulance. These agencies cumulatively respond to about 250,000 EMS 9-1-1 calls per year in the Dallas metropolitan area, transporting to more than 20 emergency receiving facilities, including 17 hospitals with 24/7 PCI labs, as well as two Level I, one Level II and one Level III trauma centers.

When I first joined BioTel Medical Director Paul Pepe, MD, in Dallas in early 2001, we found that no fewer than eight discrete PCR databases had independently developed within the BioTel member cities. No common dataset existed. Data couldn't be merged into a single dataset representing the system. To run a report as simple as "Destination hospital by age and gender of patients" required running eight separate reports, writing the results down by hand and then manually entering the data into a spreadsheet—a process that could take days.

Moreover, no standard format existed for data-tracking. In one database the administration of medications might be trackable by providers in separate, searchable fields. In another database that same data might be part of an "alpha" field and unrecoverable via a database search, which meant we couldn't monitor narcotics administration across the EMS system, for example.

In addition, a serious flaw in the system appeared when the electronic data was transmitted to the BioTel EMS office. One large EMS system could send data updates only every six months or so, rendering the electronic data of little value as a continuous quality improvement (CQI) tool.

The early part of this decade saw the proliferation of dozens of vendors of electronic patient care reporting (ePCR) software. Two of our BioTel agencies were early users of different ePCR packages; however, neither could export data, and standard field formats didn't exist. Finally, about two years ago, most of our agencies moved to NEMSIS-compliant ePCR software.

Our team understood early the advantage of this linkage, and we created an "XML importer" that would receive the data from the various ePCR vendors supporting our agencies. The importer opened the files and inserted the data into a SQL database, the framework of which is provided at the NEMSIS Web site.[1]

For the first time, our federation of cities became a "linked system" through our master ePCR database. We could analyze and compare care—apples to apples—across the region, and provide direct data support of our participation in various research trials. A cohesiveness emerged in our system that—prior to the work of such visionaries as Mears, who made the NEMSIS dream into reality—was not possible in the Dallas BioTel EMS System.

A growing number of EMS agencies are taking advantage of Philips' open Data SDK to pull monitor data into their run reports, an outstanding clinical resource for receiving hospitals.

Our initial manual XML importer project was so successful that we have completed an automated XML importer upgrade. This updated software package runs on our secure server at UT Southwestern. It watches the assigned directories for the data to arrive by secure file transfer protocol (FTP) from each agency. When data appears in the directory, the automated

XML importer sees the file, "un-zips" it, extracts the data, opens the master database, inserts the data, closes the database and closes the extracted file, archiving it for later use if necessary—all without human intervention, all on a 24/7 basis.

Dataflow improvements from our agency ePCR programs allow the BioTel system managers to:

- Enhance public health initiatives by monitoring specific incidences in the EMS system, including contact with patients carrying influenza-like illnesses or incidences of cardiac arrest victims in which no citizen CPR was initiated prior to EMS arrival;
- Observe areas of excessive utilization of EMS resources by various individuals and provide community care plans for them; and
- Carefully monitor medication administration by providers to ensure compliance with protocol, identify statistical outliers of over- and under-usage of medications and monitor the security of controlled substances.

Current & Future Prospects

Data-management opportunities in medicine abound. Several urban EMS agencies are working to make EMS ePCR data become part of the destination hospital's electronic records by importing the ePCR data upon arrival from their EMS computers to the hospital.

The next version of NEMSIS—version 3.0—is expected to leverage the HL-7 messaging protocol used by most hospital IT systems. This will facilitate two-way data communication between EMS and the hospital. EMS patient data goes in and outcome data goes out.

On another front, a notable IMMEDIATE trial involves the direct transmission of ECGs from the monitors in the field to the national study office via the Internet. Further, ECG transmission for PCI lab activation has become a mainstay of many progressive EMS systems.

Finally, and perhaps most exciting, the era of the "ICU in the field" is likely upon us with data-streaming capabilities supported by such companies as General Devices and new work in pushing a significant volume of critical care data from field monitors to receiving hospitals by Philips Healthcare.

In my work in the Dallas-Fort Worth area with Dr. John Griswell, medical director of MedStar Ambulance Service, and his colleague Dr. Jeff Beeson, I have seen outstanding evidence of what a well-crafted monitoring system brings to prehospital emergency care. The sophistication of physical assessment, electronic communication with area emergency receiving facilities, and ongoing patient surveillance reaches a level comparable with virtually any intensive care unit in a hospital.

BioTel provides critical care support to about half of the ALS ambulance transports in the greater Dallas area. The call center is based in Parkland Hospital but provides protocol approval, consultation and receiving hospital communications for a large percentage of the calls involving stroke, trauma, respiratory distress and a combination of acute and chronically ill patients.

Most receiving hospitals in the U.S. do not have the resources to monitor these patients before they arrive. But BioTel and other pioneering hospitals are beginning to provide this service to begin treating patients before they arrive. This is appropriately blurring the lines between EMS and the hospital and more closely integrating out-of-hospital and in-hospital resources.

To effectively provide this service, call centers can't rely on conversations between EMS responders and hospital providers. They need clinical patient data sent from the field before the patient arrives—and preferably during care and transport. Philips has been transmitting 12-lead ECGs on STEMI patients over the Internet to hospitals for the last four years. They are now extending this model for other critical care patients by sending vitals, ECG and Capnography waveforms while the ambulance is enroute to the hospital.

Prehospital transmission of patient data means that EMS is able to prepare the next level of care before arrival. Medical control centers or receiving hospitals can then begin triage, make space decisions, pull prior records, review the patient's history and summon specialists (or decide specialists aren't needed). This saves time, moves patients through the ED faster to other areas of the hospital, frees up valuable resources and expenditures, and expedites patient care and handoffs, returning EMS personnel to active status sooner.

It's fitting that the acquisition of patient data and its organizational application should be taking such integral steps now, during this era in which "prehospital emergency care" is rapidly becoming a medical subspecialty. Perhaps years from now, the current era will be seen as a tipping point—when EMS and its astounding world of complex data requirements and providers joined forces with the House of Medicine in an overwhelming push to a bright future.

Raymond Fowler, MD, FACEP, is professor of Emergency Medicine (Surgery), chief of EMS Operations and co-chief in the Section on EMS, Disaster Medicine, and Homeland Security at the University of Texas Southwestern Medical Center at Dallas. He is attending emergency medicine faculty at Parkland Memorial Hospital.

Disclosure: The author has reported no conflicts of interest with the sponsor of this supplement.

References

1. "Database Scripts." NEMSIS Technical Assistance Center. 17 Sept. 2007. Accessed July 6, 2009. http://nemsis.org/softwareDevelopers/downloads/databaseScripts.html.

THE VALUE OF CPAP

By David Persse, MD

HOUSTON'S DATA REVEALS SUBSTANTIAL IMPACT

In EMS, we must always be careful about making grandiose claims. However, I don't think it's going too far to say that in Houston, CPAP is revolutionizing patient care, from reducing intubations to improving the rate of patient recovery, all while reducing costs.

In a supplement in the October 2007 JEMS, I co-authored an article about a CPAP partnership between the Houston Fire Department (HFD) EMS and the Memorial Hermann Healthcare System. In that article, Michael Hewitt and I pointed out several advantages of CPAP in the EMS setting: from the clinical advantages of potentially reducing the short-term mortality of acute pulmonary edema and avoiding intubation, to the financial benefits of cost avoidance to the patient and the hospital by reducing ICU admissions and lengths of stay.

The evidence continues to mount. From April 1, 2005, through March 31, 2007, the two years prior to the implementation of CPAP within our department, HFD paramedics intubated 3,279 patients, or about 4.5 patients per day.

In the past two years since the HFD has been using CPAP (April 1, 2007, through March 31, 2009), paramedics have intubated 2,719 patients. This amounts to just 3.7 intubations per day on average.

These same paramedics have also used the CPAP device 1,173 times on patients during the same period, or an average of 1.6 times per day. An additional 10 patients had CPAP initiated by paramedics, but failed the therapy and were subsequently intubated in the field.

These data suggest that if the rate of intubation in Houston had remained constant, about half the time HFD paramedics used CPAP, they avoided an EMS intubation. An unknown number of other patients also did not require intubation in the ED or ICU.

With these data, we can safely assume the addition of CPAP to the armamentarium of paramedics has saved lives in this community. How can we make such an assumption? If for no other reason, we can make the assumption because of the avoidance of a pathologic process that few paramedics ever see or hear about—ventilator associated pneumonia (VAP).

A recent meta-analysis of the medical peer-reviewed literature demonstrated that the use of CPAP reduced the need for intubation as compared with standard therapy with a relative risk of 0.59.[1] By definition, VAP develops 48 hours or more after a patient has been on a ventilator. It complicates the course of approximately 28% of ventilated patients; more significantly, about 27% of those who develop VAP will succumb to it [2,3] Some studies have documented mortality rates as high as 65%.[4]

The Centers for Disease Control and Prevention reports VAP has accounted for approximately 15% of all hospital-associated infections and 27% and 24% of all infections acquired in the medical ICU and coronary care unit, respectively. The CDC also reports that patients receiving continuous mechanical ventilation have six to 21 times the risk of developing hospital-associated pneumonia compared with patients who were not receiving mechanical ventilation.

The pathogenesis of ventilator-associated pneumonia probably involves the aspiration of oropharyngeal or gastric secretions. This being the case, with HFD potentially avoiding hundreds of field intubations per year and an unknown number of intubations in the ED and ICU, lives have been saved not just by the use of CPAP, but also by avoiding lethal cases of VAP.

Financial benefits have been realized as well. In a recent study, mean billed hospital charges were significantly greater for patients with VAP ($104,983 ± $91,080 vs. $63,689 ± $75,030, respectively; $p < 0.001$) compared to patients without VAP.[5]

These data emphasize the benefits CPAP provides our EMS and hospital systems and, most importantly, our patients.

David Persse, MD, is the physician director of EMS and the public health authority for the City of Houston. He's also an associate professor of surgery at Baylor College of Medicine, an associate professor of emergency medicine at the University of Texas Medical School—Houston and a member of the JEMS editorial board.

Disclosure: The author has reported no conflicts of interest with the sponsor of this supplement.

References

1. Peter JV, Moran JL, Phillips-Hughes J, et al: "Effect of non-invasive positive pressure ventilation (NIPPV) on mortality in patients with acute cardiogenic pulmonary edema: A meta-analysis." Lancet. 367(9517):1155–1163, 2006.
2. Cook DJ, Walter SD, Cook RJ, et al: "Incidence of and risk factors for ventilator-associated pneumonia in critically ill patients." Annals of Internal Medicine. 129(6):433–440, 1998.
3. Collard HR, Saint S, Matthay MA: "Prevention of ventilator-associated pneumonia: An evidence-based systematic review." Annals of Internal Medicine. 138(6):494-501, 2003.
4. Kollef MH, Silver P, Murphy DM, et al: "The effect of late-onset ventilator-associated pneumonia in determining patient mortality." Chest. 108(6):1655–1662, 1995.
5. Rello J, Ollendorf DA, Oster G, et al (VAP Outcomes Scientific Advisory Group): "Epidemiology and outcomes of ventilator-associated pneumonia in a large US database." Chest. 122(6):2115–2121, 2002.

CRITICAL CHANGES

By Mohamud Daya, MD, MS & Yoko Nakamura, MD

PHILIPS MAKES KEY ENHANCEMENTS TO ITS HEARTSTART MRX MONITOR/DEFIBRILLATOR

Over the last two decades, technological advancements have allowed EMS systems to increase their focus on diagnostic and therapeutic interventions in addition to transport considerations. Modern technologies now also allow EMS systems to communicate with receiving hospitals in real time.

In this article, I'll review several new enhancements available in the Philips HeartStart MRx monitor/defibrillator: the Acute Cardiac Ischemia-Time Insensitive Predictive Instrument (ACI-TIPI), the Thrombolytic Predictive Instrument (TPI) and Connected Care Data Management solution systems.

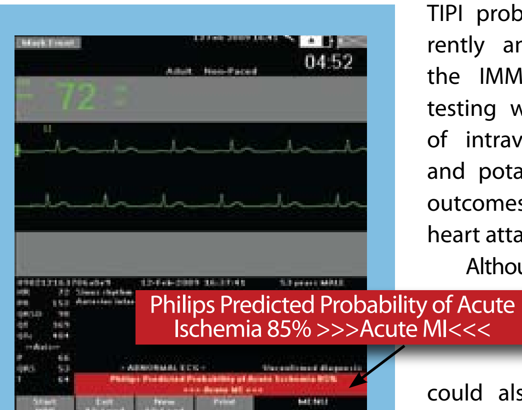


Figure 1: Using a 0–100% probability on the 12-lead ECG, the ACI-TIPI software tool enhances the analysis capabilities of the MRx by indicating whether a patient is truly suffering from ACI.

ACI-TIPI

Acute cardiac ischemia (ACI) refers to a range of important cardiac conditions, including unstable angina (UA), non-ST elevation myocardial infarction (NSTEMI) and ST elevation infarction (STEMI), that greatly benefit from prehospital intervention. The timely and accurate diagnosis of ACI remains a challenge in EMS and in the ED. To improve ED triage accuracy, Selker, et al, developed and validated an ACI predictive instrument, which was eventually incorporated into the computerized electrocardiograph.[1]

Using a 0–100% probability based on characteristics of the 12-lead ECG and several clinical factors, the ACI-TIPI software tool indicates whether a patient is truly suffering from ACI and enhances the analysis capabilities of the MRx (see Figure 1). This probability is generated on the basis of four clinical variables (age, gender, presence or absence of chest pain, and whether chest pain is the most important presenting symptom) and three ECG variables (presence or absence of pathological or significant Q waves, presence/degree of ST-segment elevation or depression and presence/degree of T-wave elevation or inversion). The ECG features must be present in at least two contiguous leads and must not be caused by exclusionary conditions (bundle branch blocks, early repolarization, ventricular hypertrophy, pacemakers) known to be associated with secondary ST and T changes.

In a large multicenter trial, ACI-TIPI was shown to improve the ED triage of chest pain patients by decreasing unnecessary hospital and Coronary Care Unit admissions.[2] Aufderheide, et al, have also confirmed the accuracy of ACI-TIPI in the prehospital setting.[3]

Although further studies are needed, ACI-TIPI could be incorporated within EMS systems in several ways. The tool could facilitate triage and transport decisions between ALS/BLS units in tiered EMS systems and help guide diagnostic considerations and therapies (aspirin, nitroglycerin, beta-blockers, etc.) in patients.[3] In fact, an ACI-TIPI probability of ≥75% is currently an inclusion criteria for the IMMEDIATE trial, which is testing whether prehospital use of intravenous glucose, insulin and potassium can improve the outcomes of patients having heart attack symptoms.[4]

Although most EMS ACS triage systems have focused on the triage of STEMI, ACI-TIPI could also be used to identify individuals with UA and NSTEMI who might benefit from triage directly to cardiac-catherization-capable facilities.

Finally, ACI-TIPI may assist ALS providers in their decision-making and risk communication when dealing with patients who are reluctant to be transported to the hospital or simply don't need to be transported.

TPI

Early use of thrombolytic therapy (within 70 minutes of symptom onset) has been shown to minimize infarct size and complications in STEMI.[5]

The Philips Thrombolytic Predictive Instrument (TPI) is a software tool that generates a predicted probability score of outcome (0–100%) for STEMI patients with or without thrombolytic therapy based on four ECG features and seven patient clinical and demographic variables. Most of these features are the same or similar to those used with ACI-TIPI with the same caveats in regard to exclusionary conditions.

In a multi-center ED trial, TPI increased both the use and timeliness of thrombolytic therapy.[6] TPI is ideal for use in 12-lead-capable EMS systems with longer transport times where it could potentially be used in conjunction with a checklist to administer thrombolytic therapy in the field.[7] TPI can also be used to enhance hospital readiness for receiving hospitals without cardiac catherization capabilities.

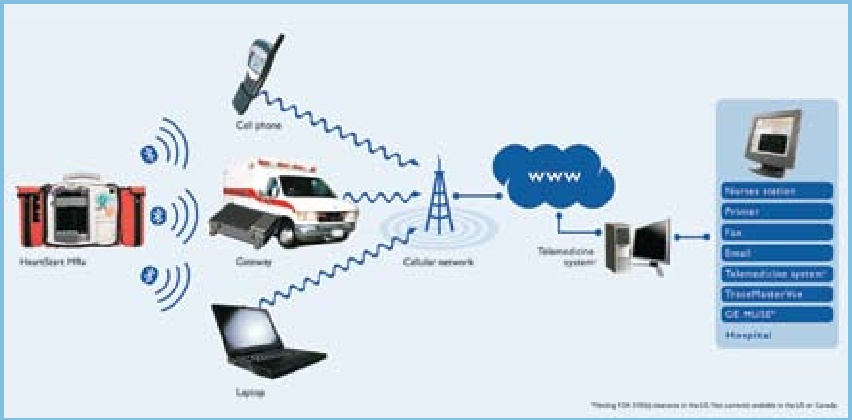


Figure 2: Wireless capabilities of the Philips HeartStart MRx monitor/defibrillator.
(GE MUSE is a registered trademark of GE Healthcare. OnBoard Mobile Gateway is a registered trademark of In Motion Technology.)

Critical Care Data Transmission Solutions

The expanded use of diagnostics within EMS has also led to the need to share clinical information with receiving hospitals in real time so that they can be better prepared to receive patients and provide remote guidance for patient care in the field. A variety of wireless and wired informatics solutions are currently available within the MRx, and these information data-sharing options are being continually refined and upgraded. Periodic Clinical Data Transmission uses Bluetooth wireless technology for periodic transmission of vital signs and 12-lead ECGs (see Figure 2).

Wireless transmission of prehospital 12-lead ECGs directly to the attending cardiologist's handheld computer has been shown to markedly reduce time to reperfusion in STEMI.[8] Transmitting and linking the clinical data collected within the MRx with an electronic patient care report (ePCR) is also important. The MRx now offers both wireless and wired solutions. Bluetooth wireless is sufficient for most clinical encounters, but larger files, such as those associated with the Q-CPR feature, are more efficiently transferred using a batch data transfer through a fast local area network (LAN) connection to a computer running software that communicates directly with the ePCR. The Batch/LAN Data Transfer option also provides an efficient flow for users who transfer patient data in batches at the end of a shift.

Summary

New software and data transmission enhancements within the MRx should help EMS systems in their efforts to deliver better care, share data with receiving hospitals and assist with post-event data management.

Mohamud Daya, MD, MS, is an associate professor in the Department of Emergency Medicine at the Oregon Health & Science University. He is also the medical director for Tualatin Valley Fire & Rescue and Forest Grove Fire & Rescue as well as the Washington County Consolidated Communications Agency in Oregon. He can be contacted at dayam@ohsu.edu.

Disclosure: Dr. Daya has served as a consultant for the Cardiac Care division of Philips Healthcare.

Yoko Nakamura, MD, is a resident in Emergency Medicine at the Oregon Health & Science University.

Disclosure: Dr. Nakamura has reported no conflicts of interest with the sponsor of this supplement.

References

1. Daudelin DH, Selker HP: "Medical error prevention in ED triage for ACS: Use of cardiac care decision support and quality improvement feedback." Cardiology Clinics. 23(4):601–614, 2005.
2. Selker HP, Beshansky JR, Griffith JL, et al: "Use of the acute cardiac ischemia time-insensitive predictive instrument (ACI-TIPI) to assist with triage of patients with chest pain or other symptoms suggestive of acute cardiac ischemia: A multicenter, controlled clinical trial." Annals of Internal Medicine. 129(11):845–855, 1998.
3. Aufderheide TP, Rowlandson I, Lawrence SW, et al: "Test of the acute cardiac ischemia time-insensitive predictive instrument (ACI-TIPI) for prehospital use." Annals of Emergency Medicine. 27(2):193–198, 1996.
4. Immediate Trial. Accessed Aug. 7, 2009. www.immediatetrial.com/index.html.
5. Weaver WD, Cerqueira M, Hallstrom AP, et al: "Prehospital-initiated vs. hospital-initiated thrombolytic therapy: The Myocardial Infarction Triage and Intervention Trial." JAMA. 270(10):1211–1216, 1993.
6. Selker HP, Beshansky JR, Griffith JL, et al: "Use of the electrocardiograph-based thrombolytic predictive instrument to assist thrombolytic and reperfusion therapy for acute myocardial infarction." Annals of Internal Medicine. 137(2):87–95, 2002.
7. Morrow DA, Antman EM, Sayah A, et al: "Evaluation of the time saved by prehospital initiation of reteplase for ST-elevation myocardial infarction: Results of The Early Retavase-Thrombolysis in Myocardial Infarction (ER-TIMI) 19 trial." Journal of the American College of Cardiology. 40(1):71–77, 2002.
8. Clemmensen P, Sejersten M, Sillesen M, et al: "Diversion of ST-elevation myocardial infarction patients for primary angioplasty based on wireless prehospital 12-lead electrocardiographic transmission directly to the cardiologist's handheld computer: A progress report." Journal of Electrocardiology. 38(4 Suppl):194–198, 2005.

STRENGTHENING THE CHAIN OF SURVIVAL

By Emily C. Esposito, BA, & Benjamin S. Abella, MD, MPhil

INCORPORATING REAL-TIME QUALITY MEASURES IMPROVES CARDIAC ARREST OUTCOMES

On Jan. 31, 2009, as a US Airways flight taxied on the Philadelphia airport runway, its passengers turned off cell phones just before their flight to the Caribbean. Among them, a 60-year-old man and his wife were eagerly awaiting departure for their anniversary celebration. The woman glanced over at her husband and noticed he'd stopped breathing.

Luckily, a paramedic and two nurses were on board. The paramedic performed CPR with the help of the flight attendants. They shocked the man with an AED and continued CPR until EMS arrived. Two shocks were required for his ventricular fibrillation, and on the second shock he converted to a sinus rhythm.

As he was transferred from the plane, the man re-arrested. EMS resumed CPR and transported him to the University of Pennsylvania hospital, where he was intubated and given epinephrine and amiodarone, while ED medical staff continued CPR with assistance from the Philips HeartStart MRx with Q-CPR* (a CPR measurement and feedback system), and defibrillated once more, this time successfully. Once spontaneous circulation was restored, he underwent induction of therapeutic hypothermia and was transferred to the ICU. After several weeks in the hospital, he experienced a full recovery with no evidence of brain or heart injury, and he has returned to his active normal life.

This case highlights the potential success that's achievable when the chain of survival is performed efficiently. From the moment of discovery to the final stages of the cooling process, the rapid execution of each critical step in this chain played a vital role in saving this man's life.

Changes in the Community

Sudden cardiac arrest (SCA) continues to be a leading cause of death in the United States, claiming the lives of more than 300,000 people each year, with half of those cases occurring out of hospital. Despite advancements in defibrillation equipment and increased attention on CPR, only 5–10% of SCA victims leave the hospital alive. These bleak statistics illustrate the urgency for improving and implementing the chain of survival in order to increase the rate of survival to hospital discharge for cardiac arrest patients. The good news: Over the past few years, we have begun to see real improvements in survival rates in many communities.

Because a victim's chance of survival decreases by 7–10% for each minute without CPR from the time of arrest, bystander intervention is crucial.[1] Public access defibrillation (PAD) programs are being implemented nationwide to increase the access to AEDs among at-risk populations and in high-traffic public areas. A landmark study in 2004 established that PAD programs can double the survival rate from out-of-hospital arrest.[2]

In 2000, the Cardiac Arrest Survival Act (CASA) was passed, requiring AED programs to be instituted in all federal buildings. In addition, the use of AEDs was added to the list of protections under "Good Samaritan" laws, which were previously enacted in all 50 states to protect the lay public from liability if first aid or CPR was performed in an emergency.

The Next Level

Following SCA recognition and bystander assistance, EMS arrival and assumption of care becomes the most critical link in sustaining the life of a cardiac arrest victim. It cannot be overemphasized that high-quality CPR performance is essential for successful resuscitation.

Studies have shown that restoration of a pulse is very sensitive to chest compression rate and depth and pauses in compressions. One study found that minimally interrupted cardiac resuscitation (MICR) dramatically increases survival rates from out-of-hospital arrests.[3] MICR emphasizes high-quality chest compressions alone, without intubation or supplemental ventilations, as the initial approach to cardiac arrest resuscitation. Unfortunately, other research has shown CPR performance to be highly variable and often inadequate, both in and out of the hospital.[4] This includes inadequate compression rate and depth as well as hyperventilation, all of which are detrimental to patient survival.

In an attempt to improve performance, CPR measurement and feedback systems, such as the Philips HeartStart MRx with Q-CPR*, monitor performance and provide real-time feedback to the caregiver. Such devices measure compression rate, depth and ventilation characteristics in order to ensure high-quality CPR performance during an actual cardiac arrest. Recent studies in both EMS and hospital care have shown improved rates of pulse restoration with the use of these devices (see sample feedback at right).

As CPR quality initiatives continue to grow, the practice of using real-time measurement and feedback during the resuscitation, combined with regular debriefing sessions using the data captured during patient events, has shown promising early results. Research has shown that debriefing with data obtained from measurement and feedback tools can increase subsequent CPR performance and improve outcomes from in-hospital SCA.[5]

Recent advancements in both real-time feedback and debriefing programs are working together to improve the overall quality of care in the chain of survival. Consequently, these programs provide a unique opportunity for EMS professionals to review and strengthen their CPR performance, providing a new means for improving outcomes of out-of-hospital arrests.

Conclusion

During the transition from initial arrest to hospital arrival, EMS personnel must continue to work diligently at performing high-quality CPR. Measurement of and feedback about CPR with follow-up debriefing helps improve the quality of CPR and the likelihood of the return of spontaneous circulation (ROSC).

Post-resuscitation care, specifically therapeutic hypothermia, can then be performed once ROSC is obtained. Some professionals are beginning to consider therapeutic hypothermia the "5th link" in the chain of survival. (For more on hypothermia, read "Regionalized Cardiac Arrest Care" on p. 6.)

Strengthening the links within the cardiac chain of survival has the potential to significantly improve outcomes of cardiac arrest victims. SCA survival statistics demonstrate how detrimental a weakness can be in any one of the critical links involved in this sequence. The rescue efforts on the US Airways flight illustrate what can be accomplished when the chain of survival is executed swiftly and decisively.

Philips Q-CPR meter enables the caregiver to rapidly adjust performance by displaying dynamic, real-time feedback for each compression, directly on the patient's chest.

Emily C. Esposito, BA, is a student in the Special Science Post-Baccalaureate Program at the University of Pennsylvania and serves as a full-time research assistant to Dr. Abella in the Center for Resuscitation Science at the university. She has a bachelor's degree in psychology from Villanova University and plans to attend medical school in 2010.

Disclosure: Ms. Esposito has reported no conflicts of interest with the sponsor of this supplement.

Benjamin S. Abella, MD, MPhil, is the clinical research director of the Center for Resuscitation Science at the University of Pennsylvania, where he clinically serves as an emergency department physician. His work is focused on CPR delivery and quality of resuscitation care, and he has written and lectured extensively on cardiac arrest and post-arrest therapy.

Disclosure: Dr. Abella has reported receiving honoraria and/or research support, either directly or indirectly, from the sponsor of this supplement.

References

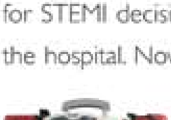
1. Aufderheide T, Hazinski MF, Nichol G, et al: "Community lay rescuer automated external defibrillation programs." Circulation. 113(9):1260–1270, 2006.
2. Hallstrom AP, Ornato JP, Weisfeldt M, et al: "Public-access defibrillation and survival after out-of-hospital cardiac arrest." New England Journal of Medicine. 351(7):637–646, 2004.
3. Bobrow BJ, Clark LL, Ewy GA, et al: "Minimally interrupted cardiac resuscitation by emergency medical services for out-of-hospital cardiac arrest." JAMA. 299(10):1158–1165, 2008.
4. Wik L, Kramer-Johansen J, Myklebust H, et al: "Quality of cardiopulmonary resuscitation during out-of-hospital cardiac arrest." JAMA. 293(3):299–304, 2005.
5. Edelson DP, Litzinger B, Arora V, et al: "Improving in-hospital cardiac arrest process and outcomes with performance debriefing." Archives of Internal Medicine. 168(10):1063–1069, 2008.

*Q-CPR is a registered trademark of Laerdal Medical

What inspired our EMS innovation? Making treatment decisions faster.

Time is crucial in emergency care. Only the Philips HeartStart MRx provides EMS professionals with new tools for STEMI decision support, allowing more confident diagnosis and cath lab preparation – before arriving at the hospital. Now enhanced clinical data can be sent ahead to the waiting hospital, quickly and easily, reducing critical time to lifesaving treatment. To learn more, please visit us at www.philips.com/ems.

*Because our innovations are inspired by you.



JEMS Hot Products 2009

PHILIPS

sense and simplicity