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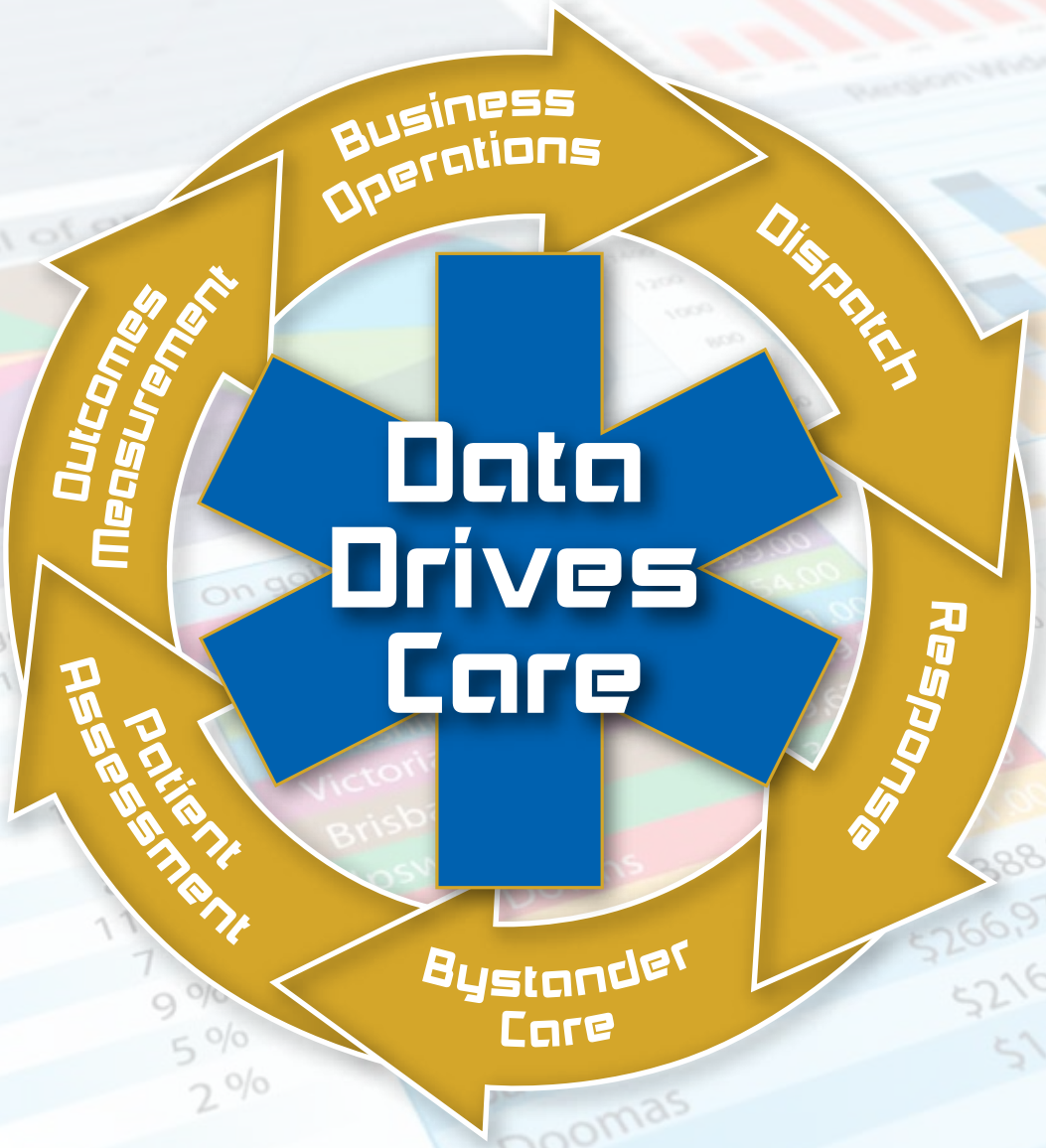

How data collection and use helps save lives

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The Data-Driven Paradigm

5 keys to success in the new, performance-driven, integrative EMS environment

By Greg Mears, MD

It is an exciting time in EMS system development. So many external forces have driven us over the years. In the 70s we were born; during the 80s we focused on operations and their impact on patient care; during the 90s came the development of trauma centers and the beginning of "Systems of Care"; during the 2000s, we focused on data systems, billing and high-performance implementations.

The decade leading up to 2020 will continue to build on these foundations, with an increased need to show our ability to provide quality service and patient care at a reasonable cost or value.

To be competitive in this new affordable healthcare model, EMS must expand its focus beyond individual patients to the health and wellness of the community. This integration with healthcare systems, focusing on the needs of both the patient and the community, will determine our success and our outcomes.

Integrative EMS service delivery also changes our historic operational focus, from managing multiple patient-centric events—most of which require transport—to a community-centric approach, where patients are managed based on their true clinical and social needs, often without transport.

In this new paradigm, there are five keys to our success. These five things represent both the dogma for the EMS 2020 movement and an organizational approach for success.

1 EMS is the practice of medicine. EMS is much more than a friend of the community or a ride to the hospital; it is the practice of medicine. We are practicing medicine and have a responsibility to provide high-quality care derived from evidence-based performance measures and outcomes.

2 EMS operations often can't be separated from the medicine. Other areas of healthcare are just now beginning to figure this out, including trauma, STEMI, and stroke systems of care. We have known it from the beginning. EMS must continue to evaluate, evolve and integrate our operations with our clinical care and our community healthcare systems. That is the only way to maximize our impact on outcomes.

3 Outcomes are difficult to measure, but critical to our success. There is a saying, "In God we trust, all others bring data." EMS is the most complex component of healthcare but that complexity is what allows performance improvement and outcome measurement to be successful in driving our future. NEMSIS, CAD systems, electronic medical devices and our early adoption of electronic health records are incredible resources we are just beginning to ride as we take off on this journey.

4 EMS is not an island; it's the bridge. EMS was the first medical specialty to realize that healthcare cannot be successful if delivered in silos. The future is in "systems of care." We are the bridge to success in performance-driven healthcare across communities.

5 Software and devices are a part of the healthcare team. This is a "Terminator" type of thought, but the machines have evolved. We are in the middle of a paradigm shift. Devices were once tools in our toolbelt we used as needed in the provision of patient care. Devices are now much more that that—they are now a member of our healthcare team. They provide information, guidance, insight and a level of intelligence directly connected to positive outcomes.

This special supplement to *JEMS* was designed with great thought and input from industry leaders. Its goal is to provide an overview of how technology and data touch each of the components of an EMS system of care. Learn why and how the incorporation of data and technology, as a member of your healthcare team, is critical to success as we move toward EMS 2020.

ALEX GARZA MD, MPH

FirstWatch medical director and former chief medical officer for the U.S. Department of Homeland Security

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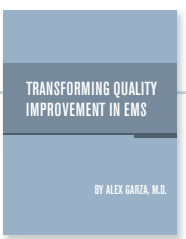

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Today, the dispatch center is no longer really a dispatch center; it now functions as a "clinical hub."
PHOTO KEVIN LINK

Saving Lives Begins Here

New data sources & technology transform the dispatch center into a clinical hub

By Jerry Overton

Not that long ago, the dispatch center was just a room located in a basement or the back of an office, staffed by a person "trained" to answer a telephone and push a microphone button, with a data set generally gathered on a paper log with a pencil. Times have really changed.

One needs look no further than the "Chain of Survival" to understand the importance of today's dispatch center. Immediate activation of response agencies, early CPR, rapid defibrillation and early and effective ALS initiation all emphasize the need for minimizing time and accurate decision-making. The success of each of these important components is directly impacted by trained dispatchers and the technological tools at their disposal.

One of the axioms of EMS response is that if it doesn't go right at dispatch, there is little chance for the *patient*. In the modern world of fewer unit hours, increased demand for service, higher expectations and stressed revenue sources, that axiom is now: If it doesn't go right at dispatch, there is little chance for the *system*.

The dispatch center is no longer really a dispatch center. About 10 years ago, it could have been termed a control center, but even that has changed. Now, with responsibilities that include protocols for "hear and treat" and "see and treat," and interfacing on a regular basis with the other components of the healthcare community, it truly can be termed a "clinical hub."

To be effective and efficient in this role, accurate data is needed—because data drives outcomes. This article will provide an understanding of the diverse data sources and the uses of data in this new world. It all begins here.

Ensuring That the First, First Responder Is *First*

The first point at which accurate data on any emergency can be captured in most systems is when outside communications are received at the initial answering point. However, response time in most systems starts when the call is received at the *EMS* dispatch center. I mention this now because this is "lost" data, and, more importantly, a lost opportunity.

With *immediate* activation of response emphasized as the first link in the Chain of Survival, obtaining this data is extremely important for analytical purposes. Ironically, technology *may not be the limiting factor*, because these centers often employ sophisticated Computer Aided Dispatch (CAD) hardware and software programs. Rather, there seems to be a reticence by

many initial answering points to provide that data because of the concern that it will disclose a significant delay in call processing. This data becomes increasingly important, however, as the focus on response times transitions from outputs, where arbitrary response times are measured and outliers penalized, to clinically significant, evidence-supported outcomes.

"Okay, Tell Me Exactly What Happened"

After capturing the address of the emergency and the call-back number, the highly trained Emergency Medical Dispatcher (EMD) starts the clinical assessment of the patient in a matter of seconds. Similar to the paramedic's field protocols, the protocols used by the EMD are medically approved and founded in clinical evidence. They require the EMD to interrogate the caller for demographics, characteristics and the patient's general problem, and then ask further specific systematized questions to determine the acuity level of the patient and the proper system response needed. This is all driven by data!

Without a doubt, every EMT and paramedic reading this article has responded to a "shortness of breath" call with red lights and siren, only to arrive and find a non-acute patient breathing relatively normally. That can lead them to question the reliability of the data, if, in fact, dispatch protocols are so data-driven. It is an interesting question with an explainable answer.

The Medical Priority Dispatch System (MPDS) is the mostly widely used protocol. It is also the most studied and has a large evidence base to support its clinical foundation. Everything MPDS does is based on data.

First, it is important to understand that the MPDS is designed to over-triage patients because the EMD is not actually with the patient and can't see the patient. This will probably change as technology evolves, but for now it is the reality. Hopefully most people will agree that it is better to over-respond to the patient not in respiratory distress than to under-respond to the patient who was actually breathing agonally and is found to be in cardiac arrest.

Second, the published peer-reviewed evidence shows that the MPDS process really does work. Each action of the EMD is captured as a data point within the MPDS software, resulting in the assignment of a patient condition, or "determinants." Currently there are more than 300 determinants in the system.

After the MPDS system was introduced at the London Ambulance Service, it showed a 200% increase in the identification of cardiac arrest over the next three years.[1] Similar studies have shown the accurate identification of chest pain, seizure and stroke patients.

Equally important for EMS systems today is the use of data by the EMD to identify the non-acute patient. This is not only feasible using a structured dispatch protocol system, but peer-reviewed research has proven that it can be done—and is safe. In fact, in one study it was found that 99% of the calls triaged as "alpha," the lowest acuity category, did not meet any higher acuity criteria.[2]

This data is extremely important for the dispatch center. Not only does accurate triage save valuable ALS resources for the critical call, but accurate triage of these calls by the EMD can provide that caller with better, more appropriate resources outside the traditional 9-1-1 system. For example, by linking the MPDS dispatch software to nurse triage software, the Louisville EMS system and MedStar Mobile Healthcare in Fort Worth, Texas, have safely implemented telephone triage, or "hear and treat."

This type of dispatch system is also a key for community paramedicine. Without data driving the process, the community paramedic, or advanced paramedics as they are called in England, would not be as successful as they are now. With the rapid spread of community paramedicine to the United States, it is imperative that the dispatch system, and clinical hub concept, be founded on dispatch data, and that data be clean, unbiased and accurate.

The CAD: Data, Data, Everywhere

The pencils and paper logs are long gone, hopefully, replaced by all kinds of new CAD technologies. In fact, in many dispatch centers, it is hard to find a piece of paper anywhere. It is all software-driven, with complex interfaces linking the call-taking to the CAD and the CAD to the field. With these programs, there truly is data, data, everywhere, and the chances of the data being accurate are almost 100%, as long as it's entered accurately—which often requires no more than a push of a button.

More can now be learned sooner to speed the response with the right resource. In the past, most dispatch programs just captured times as follows: Call Received; Unit Alert; Unit En Route; At Scene; En Route to Hospital; At Hospital; and In Service.

Of course, there were variations, but those were the basics. The data was then converted into reports as follows, with the first leading the way: Response Time; Response Time Exceptions;

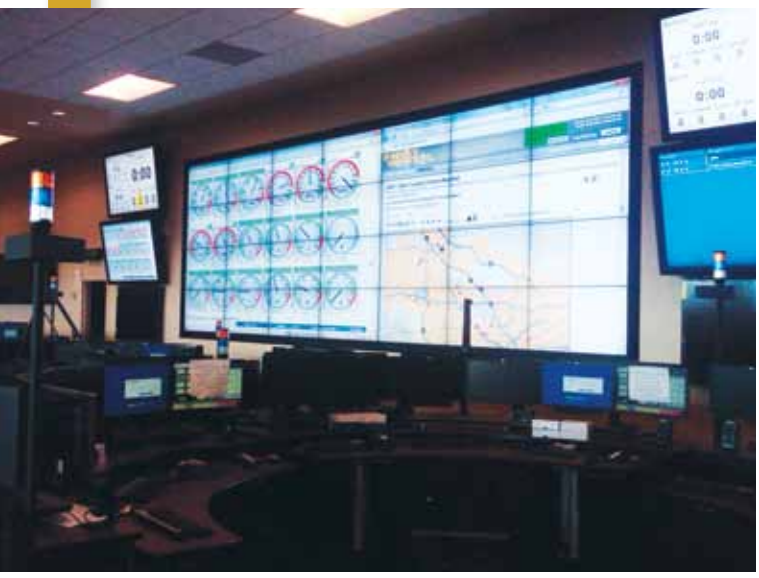

PHOTO FIRSTWATCH

The Los Angeles Fire Department uses a HIPAA-compliant "dashboard" system to monitor operational indicators such as dispatcher call-processing times, track unit locations and determine coverage gaps. Such systems can also be used to alert the comm center of the early signs of a chemical, biologic, radioactive or nuclear attack.

Dispatch Processing Times; Unit En Route Times; and Percent of No Transport.

Those reports and others allowed system managers to attempt to identify outliers and hopefully, make positive changes in a timely manner. That timely manner often actually meant providing feedback a month or two later. With data driving care, this would all be a little late.

A supervisor involved in strategic deployment strategies, or as it is more commonly known (and often despised), system status management, faced even more obstacles. Hand-entered data, maps on walls, and acetate with erasable markers were the tools of the day. It is no wonder the skeptics had the advantage. By the time a system status plan could be developed, it was outdated.

Fast-forward to 2014 and the world of real-time data. With a plethora of CAD systems and software applications, the opportunity for care to be driven by data *instantaneously*, and in a "predictive" manner, is almost limitless. Again, it all begins at dispatch—the hub.

Many communications centers, such as those serving Louisville; Reno, Nev.; Fort Worth, Texas; and Richmond, Va., use FirstWatch software to monitor operational indicators such as dispatcher call-processing times to provide 9-1-1 center supervisors and dispatchers with real-time feedback. Information captured by a dispatcher or call-taker and entered into the CAD can be monitored automatically by FirstWatch in real time along with software like ProQA, which provides structured dispatch protocols.

With this combination, even the "unstructured" information that a dispatcher enters into the "notes" field can be monitored for key words or phrases. Some centers link their phone, CAD and ProQA data systems to interface with FirstWatch from first call ring throughout the call-taking/dispatch process. Many EMS systems then link that call center data to ePCR data, and some, like Sedgwick County EMS in Kansas, even link that to hospital data, for measurement of performance outcomes.

Regardless of the evidence, the focus on some semblance of a response time standard will never be eliminated. The key will be to ensure that there is sufficient coverage to meet a standard and at the same time maintain resources to treat the vast majority of the patients accessing the system in an economically challenged environment. With real-time data collection, interpretation and feedback, this has become much easier.

Understanding the possibilities is a first step, beginning when the 9-1-1 call is received. With the appropriate interface, both the address and the telephone number automatically populate the call-taker's screen. Within 30 seconds the call-taker uses MPDS to process the call as life-threatening and, using another interface, transfers the data to the CAD, which then automatically populates the dispatch software.

At this point, based on available software applications and real-time data, the dispatcher's decision becomes one based on education rather than assumption. Many EMS systems use Automatic Vehicle Location (AVL) software that continually transmits vehicle location and availability to the dispatch center using another interface. At a glance, the dispatcher knows the options. Other programs, specifically mapping, also may be available to show coverage, or lack of coverage, the best route for the vehicle, any obstacles that might be encountered (think bridges, trains, road work), and, based on time of day, traffic.

The decision is made and the rest is a push of a button. The crew is notified, the time automatically stamped, and even the route automatically recorded. Another push of the button by the crew on arrival at the scene and an accurate response time is recorded. Dispatch then looks at the real-time map again, determines both the location of the coverage gaps and the likelihood of where the next life-threatening emergency will occur, and moves the remaining available units. These actions take only seconds, and the coverage plan remains optimized.

Operationally, the collection of data like this quickly opens new doors for supervisors and managers. Every aspect of the operation can be monitored and performance measured. Although it's true that the focus of data collection can be on the individual dispatcher, in a performance-based EMS agency, the collection and use of data is best served when it is used to make system analysis easier and system changes faster. Understanding the complex nature of a dispatch center and the almost overwhelming responsibilities involved with the data are inextricably linked to better clinical care.

Clinically, real-time dispatch center data also saves lives. Using mapping, or GIS, the locations of past cardiac arrests can be plotted along with the time of day and response times. This leads to interfacing with coverage maps, AVL and the ultimate timely response. Although evidence has proven that the eight-minute response time standard is arbitrary, the same evidence shows that interventions at the four- to five-minute mark after a cardiac arrest markedly improve survival. This is data that saves lives.

In addition, by combining the MPDS system with dispatch notes, medical directors and clinical supervisors can be automatically notified of specific clinical events, including cardiac arrests, chest pain or high-risk pregnancy. Combining this dispatch data with the data collected on board the unit, such as 12-lead EKG or specific PCR documentation, can create quick and effective quality improvement loops.

Expanding the Clinical Hub

Data can also play a part in driving clinical care through the use of non-traditional applications within the clinical-hub concept. The following are but two examples.

The threat of anthrax terrorism following the events on Sept. 11, 2001, along with the SARS outbreak experienced by Toronto EMS in 2003 and the more recent panic when it was believed that H1N1 would create the biggest influenza epidemic since 1919, clearly demonstrated the need for syndromic surveillance. The U.S. is unique in that it has real-time detection technology developed by FirstWatch that uses trigger alerts based on accumulated MPDS data to detect possible disease outbreaks.

FirstWatch data, which uses secure processes and meets HIPAA requirements, is presented on "dashboards" so users can instantaneously see the status of any dataset. FirstWatch is also set by many systems to alert the comm center of the early signs of a chemical, biologic, radioactive or nuclear attack, or for naturally occurring events like epidemics.

FirstWatch can also send an automated page or email, or both, to provide advance warning of an event. When I was the chief executive of the Richmond (Va.) Ambulance Authority, for example, FirstWatch predicted a flu outbreak in the city two days before the public health director received his notification. Automatic alerting software such as this reduces workload and increases awareness by automating key notifications for sentinel or situational awareness events, such as the explosion of a bomb or suspicious clusters of patients that could be an indicator of an epidemic.

Where the U.S. lags is in the registry of automatic external defibrillators (AEDs). For instance, in Denmark there is a National AED Network that has placed an AED for every 1,100 people, and the appropriate dispatch center knows where each is placed and can direct the responder to the closest location. While AEDs clearly play a part in the chain of survival, where they are can be a mystery without a registry. The time has come to be aggressive, and the place to link the registry is in the clinical hub.

Driving the Chain

With the changes in dispatch technology over the past 10 years, one can only speculate about the future. Whatever the direction, the concept of the chain of survival and the need for speed will remain as new methodologies, medications and techniques are discovered. For these new elements to reach the patient, the dispatch clinician will need the best data available to initiate all links in the chain. It all starts at dispatch. ✚

Jerry Overton serves as the chair of the International Academies of Emergency Dispatch, the organization charged with setting standards, establishing curriculum and conducting research for public safety dispatch worldwide. Previously, he served as the president/CEO for Road Safety International, CEO for the Richmond (Va.) Ambulance Authority and chief executive of the Kansas City, Mo., EMS system. As an expert in EMS system design and response deployment strategies, Overton was named one of the 20 most influential leaders in EMS by JEMS *magazine.*

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Safety on the Streets

Event data recorders, driver safety monitoring & traffic light control systems are key to reducing ambulance crashes

By David R. McGowan, ASHM

If a proposal by the National Highway Traffic Safety Administration (NHTSA) is successful, by 2014, all new vehicles sold in the U.S. will be required to have event data recorders ("black boxes") installed. In fact, a recent report by the *New York Times* estimated that this technology is already standard on 96 percent of all new cars and light duty trucks.[1] In passenger vehicles, the event recorders will capture specific data to assist law enforcement in their investigation to determine culpability in crashes. Fourteen states now allow access to the data via warrant.

The data contained in these recorders will eventually find its way to safety researchers to assist in designing safer vehicles. It's unknown how or when the data will go beyond technical research and into other "legitimate" interested parties—it's not a matter of if, but when.

Black boxes aren't new technology; the aviation industry began using a first-generation device in the 1940s. In 1965, all commercial airliners were required to have a voice and data recorder installed on all their aircraft. These flight recorders assisted in the investigation of air crashes and provided invaluable information that has shaped the safety standards in commercial aviation. It's no coincidence that travel by air today is the safest mode of transportation by distance traveled.

As EMS emerges from the days of Cadillac ambulances, it's becoming obvious that in spite of the advances in equipment, training, leadership and clinical oversight, EMS staff, their patients and the public are still at a risk. Ambulance crashes are the number one cause for provider deaths and injuries and the resulting financial burden is nearing $750 million annually.[2,3] Unlike our colleagues in the aviation industry, however, we don't have enough data to pinpoint all the contributing factors of ambulance crashes.

Catching Up with the Clinical Side

Without data, and the means to collect, interpret, recommend and report it, improvements will be slow or non-existent. EMS is a dynamic industry and the strides it has made to date to improve patient care and outcomes could not have happened without robust and accurate data. Electronic capture of this information and its communication to data sources is seamless and relatively effortless today.

In the U.S., organizations such as NEMSIS and CARES provide clinicians and leaders with accurate and concise data to help improve their efficiencies and clinical outcomes. With regard to patient safety, several organizations now allow for anonymous event reporting and data analysis that can be used to develop policies and training programs that will prevent unsafe patient events industry wide. E.V.E.N.T (EMS Voluntary Event Notification Tool) is an excellent example.

Unfortunately, ambulance crash data has not evolved at the same pace as clinical and operational metrics. Crash data in the U.S. is largely collected by state government agencies and forwarded either by request or mandated to federal agencies for their review.

Each state is unique in the data it captures; some don't even have a vehicle classification for ambulances. On the federal level, one of the most widely respected organizations is NHTSA.

Within the organization there are several other groups that receive and analyze crash data: the National Automotive Sampling System, Special Crash Investigators State Data System, Crash Outcome Data Evaluation System and the Fatal Accident Reporting System.

Beyond the scope of data that each of these organizations collects and analyzes is another subset of data that is not retrieved. Ambulance providers now have a powerful tool to collect data and change unsafe driver behavior. Just like the event data recorders found in aircraft and passenger vehicles, EMS and fire organizations now can install safety devices that are engineered to be deployed in emergency vehicles. Such devices are similar to the black boxes found in aircraft; they record vital vehicle operation inputs such as speed, g-forces, engine RPM, seatbelt usage and the operation of a backup spotter, lights, sirens, turn signals and brakes. There are two advanced capability "black box" systems available to EMS operations today: Ferno's Acetech system and ZOLL's RescueNet Road Safety System.

The data from these devices are constantly downloaded, reviewed and interpreted by trained individuals. The data that is collected not only measures vehicle, but driver performance as well. The system provides an instant audible alert to the driver if unsafe driving parameters are closing in or exceeded, which effectively changes behavior. These parameters are user-defined, which allows for flexibility determining the scope and location of the provider.

The systems use an algorithm to score individual drivers to determine if they are compliant with agency driving policies. It measures miles driven and then calculates the number of violations (speed, high g-forces, seatbelt not fastened and no spotter for reverse operation) and provides the driver with a score between 1 and 10 (the higher number being less unsafe). Service operators will determine a minimum number that all drivers must meet.

Having this data available has other far-reaching benefits. If the ambulance is involved in a crash, the data from the vehicle can be used to factually dispute false claims by other parties. The same is true when speeding complaints or semaphore violations are received from the public. The data will confirm or refute the claim.

When evaluating and selecting a vehicle safety question, consider the following factors:

- **Focus on safety of first responders.** Vehicle safety technologies must monitor key safety parameters—including backup spotters, lights and sirens, seatbelts, turn signals and driver identification—to proactively stop factors leading to aggressive and unsafe driving.
- **Reliability.** Many vehicle safety products are primarily focused on large fleet applications such as commercial vehicles and mass transit. Is the vehicle safety technology proven to withstand the rigors of EMS? How long has the technology been successfully used in accident investigations and litigation? Are customers willing to vouch for the system's performance and financial impact?
- **Designed to grow as EMS evolves.** Will the technology expand in functionality as the EMS agency grows (e.g., wireless communication and software application technologies)? How committed is the technology vendor to the emergency response industry? When features are added to the system, how disruptive is this upgrade to the EMS operation?
- **Emphasis on safety training.** A committed technology vendor will act as a partner to help guide and instill safety practices throughout an organization—not as an afterthought. What services are offered to ensure that the vehicle safety system is used to its full potential? What guidance is offered to customers to implement best practices?
- **Implementation and support.** How seasoned is the team that will install, train staff and support the vehicle safety system? Were past customers satisfied with the implementation process?

IMAGE ZOLL

Intelligent dispatch systems that track fleets by GPS are constantly collecting data: vehicle speeds by location, day of the week and time of day. By "learning" this information, dispatch systems can provide preferred routes to a given call, reducing response times and fuel consumption.

Reporting & Sharing

As of today there is no voluntary reporting of ambulance crash or driver safety data to any organization. Service operators do not want to allow

this information to fall into the wrong hands because it could have deleterious effects on the organization. Withholding this information, however, will only delay the progress of achieving a much safer medical transportation mode.

Our colleagues in the aviation industry have this figured out, and its success is well documented. The Aviation Safety Reporting System (ASRS) is a confidential, voluntary and non-punitive organization that allows submissions from all aviation sources. Where EMS has E.V.E.N.T., their submissions do not include ambulance crash information to the degree that can be impactful.

A relatively new organization in EMS that is taking strong strides to mirror that of ASRS is the Emergency Medical Error Reduction Group (EMERG). EMERG's mission is to facilitate a cultural shift within EMS to embrace a fully integrated, rapid and continuous improvement effort that reduces the occurrence and impact of accidents and preventable errors on providers, patients and the populations served. As a U.S. federally certified patient safety organization, EMERG may be the right destination for our ambulance crash and event recorder data.

Other Response Technologies

Another device that has successfully improved vehicle safety controls the signal lights at an intersection. Developed more than 35 years ago by 3M in St. Paul, Minn., Opticom (or Emergency Vehicle Pre-emption) has a proven record of reducing intersection crashes for emergency vehicles. This signal priority control system eliminates right-of-way conflicts at intersections. As emergency vehicles approach the intersection, an emitter on the vehicle sends a signal to the traffic control processor. The processor then changes the intersection signals to stop all traffic with the exception of the direction the emergency vehicle is traveling. If another emergency vehicle approaches the intersection from another direction, a white signal light located on top of the signal stanchion will flash or remain on, indicating which vehicle has priority in the intersection. This system now uses GPS technology to trigger the system where line of sight to the intersection is hindered.

In addition, data derived from GPS systems has improved efficiency and safety for EMS and fire organizations. Intelligent dispatch systems that track fleets by GPS are constantly collecting data: vehicle speeds by location, day of the week and time of day.

By "learning" this information, dispatch systems can provide preferred routes to a given call that otherwise would be congested with heavy traffic or numerous intersections. In predictive dispatch systems, the data can enhance dynamic vehicle deployment by placing ambulances in positions that historically have the highest call volume by time of day and day of week.

Getting an ambulance closer to a call not only reduces response times, it enhances efficiency and reduces fuel consumption. From a safety aspect, an ambulance that does not have to travel a great distance and avoids heavy traffic is less likely to be involved in a potential crash.

Continuous Improvement

Data drives EMS leaders to make informed decisions, relying on facts rather than conjecture. The data gleamed from the above technology, when combined with PCR, dispatch, billing and scheduling data, provide agencies the essential information to evaluate performance and make improvements if warranted.

As this data become more readily available, EMS services have an obligation to share it with non-profit EMS improvement organizations, who in turn can benchmark performance and identify best practices.

With much talk about pay-for-performance as a reimbursement model for EMS in the future, how an EMS system performs and its percentile ranking in key areas will be critical to its revenue stream. Aside from clinical performance, a key metric that should not be overlooked is patient injuries due to an ambulance crash. Vehicle event data will be a significant driver of these rankings. ✚

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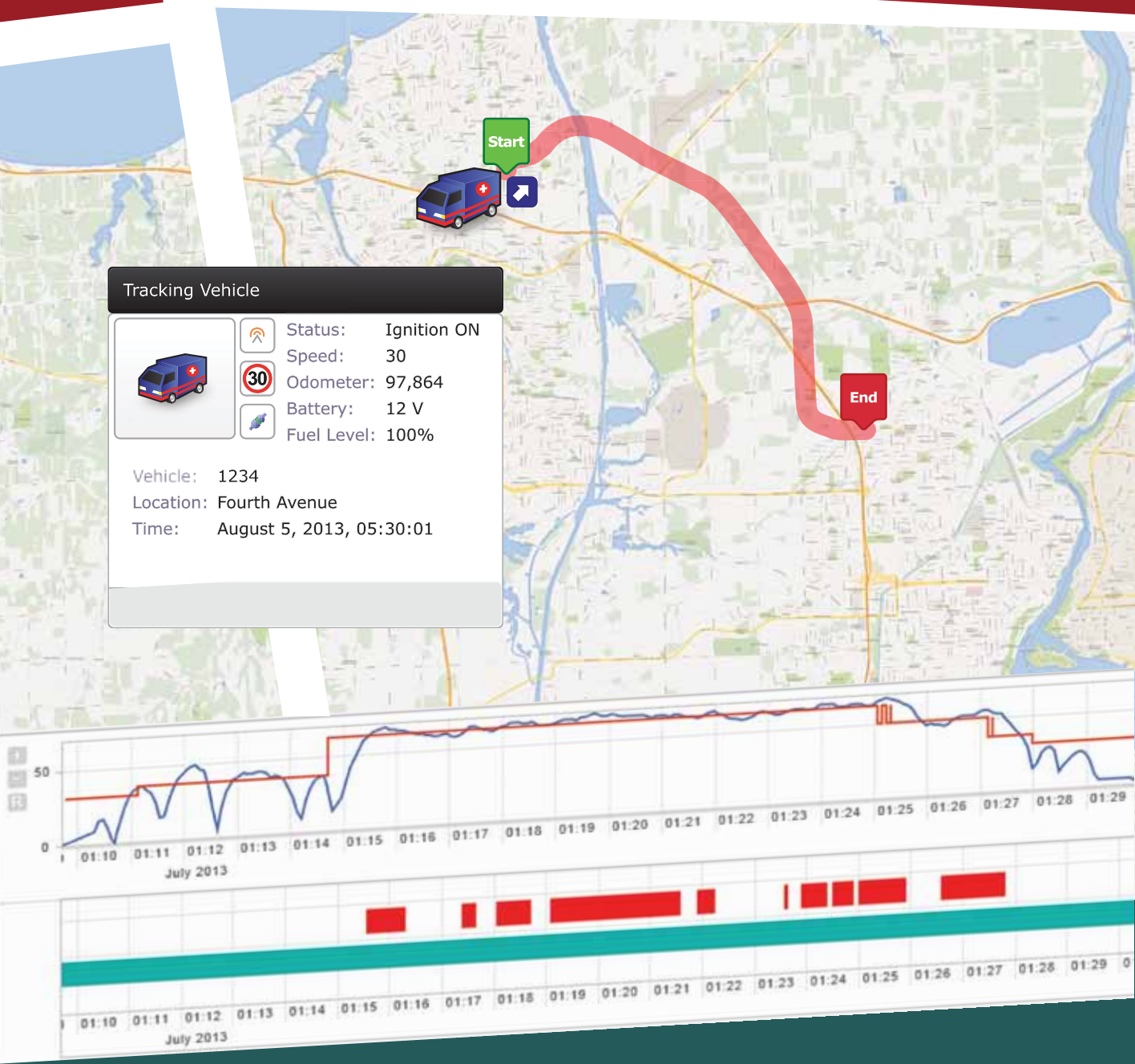

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The Case for AED Registries

Integrating novel strategies to measure & increase bystander CPR & AED use—& save more lives

ISTOCKPHOTO/JSTECK

By Bentley J. Bobrow, MD

Bystander CPR is a critical link in the chain of survival. It has been shown to more than double a victim's chance of surviving an out-of-hospital cardiac arrest (OHCA).[1] Using an automated external defibrillator (AED) in addition to performing bystander CPR further improves the chances of survival.[2] Yet, both bystander CPR and AEDs are *not* provided in a majority of OHCA events.[1,2]

Because time is so critical in cardiac arrest, immediate bystander action (calling 9-1-1, performing CPR, and early defibrillation) is the cornerstone of maximizing the effectiveness of subsequent EMS and hospital interventions and ultimately survival. This is especially true in rural and congested urban areas with prolonged response times.

Bystander CPR lengthens the duration of ventricular fibrillation (VF) and provides critical blood flow to the heart and brain during cardiac arrest.[3] This improves the likelihood of shock success, return of spontaneous circulation (ROSC), survival, and the chance of a good functional outcome.[3,4] The combination of quickly calling 9-1-1, immediately doing chest compressions and applying an AED as soon as possible works synergistically to increase survival. Each of the successive links in the chain of survival depends on the preceding links—the whole is greater than the sum of the parts.

Because time is so critical in cardiac arrest, immediate bystander action is the cornerstone of maximizing the effectiveness of subsequent EMS and hospital interventions and ultimately survival.

Because of this, EMS (in fact, our entire healthcare system) has a vested interest in the delivery of care before the arrival of professional rescuers on scene. Everything EMS does to improve the readiness of lay rescuers (training, public awareness, 9-1-1 pre-arrival instruction, assistance locating AEDs, etc.) will pay heavy dividends in an increased survival rate in our communities.

Measuring Interventions

There is wide and unacceptable variability in cardiac arrest outcomes between communities,[5] which likely results from differences in implementation and performance of important interventions such as 9-1-1 pre-arrival CPR instructions, bystander CPR and early defibrillation. Continuously measuring these interventions and analyzing their impact is the only way to know specifically what needs improvement and whether a system is functioning as intended.

Current registries exist to help communi-

ties measure their cardiac arrest incidence and outcomes. The CARES (Cardiac Arrest Registry to Enhance Survival; https://mycares.net) registry is a national data collection system for OHCA. This registry includes data collection on OHCA incidence and process of care, including bystander CPR, AED use and, recently added, data for 9-1-1 pre-arrival CPR instructions.

The need to take this a step further and systematically track data from 9-1-1 centers has come about due to the realization that the *quality* of telephone CPR instructions has a significant impact on survival. Details such as whether the cardiac arrest was correctly identified, whether CPR instructions were provided, how long into the 9-1-1 call before CPR was started, and what type of CPR was given can make the difference between life and death. There is growing interest in pre-arrival CPR metrics and the need to quantify this critical intervention. To illustrate the point: If the 9-1-1 system provides pre-arrival CPR instructions at eight minutes into a call, it will obviously have much less impact on survival than if the instructions were provided one minute into the call. And yet both callers received "pre-arrival CPR instructions."

The state of Arizona and King County, Wash., have piloted a data collection tool and reporting system for suspected cardiac arrest dispatch calls, which is integrated into their OHCA registries and linked to EMS care, hospital care and patient outcomes. In Arizona, the 9-1-1 pre-arrival CPR program is part of the Save Hearts in Arizona Registry and Education (SHARE) Program, a collaboration between the Arizona Department of Health Services and the University of Arizona (see http://azdhs.gov/azshare/911/index.htm). The Arizona and King County, Wash., models have now been incorporated into CARES to help dispatch and EMS systems across the country.

Why You Need an AED Registry

Like bystander CPR data, AED information is a critical component of an ongoing cardiac resuscitation system of care. When various data points along the continuum of care (bystander CPR, 9-1-1 data, AED placement/use, and outcomes)

IMAGES COURTESY PULSEPOINT

The PulsePoint App sends real-time AED location information to those within a certain radius of a suspected cardiac arrest, with the goal of increasing both bystander CPR and AED use. At press time, there had been more than 1,000 activations of the system.

are integrated into a standardized registry, such as CARES, an entire system can be measured and improved over time.

AED information needs to be integrated into registries in order to know where AEDs are placed, if they are checked for maintenance (pads, batteries), if potential users are trained on-site, when they are used, and the ultimate patient outcome. Event data should include the location of the arrest, who did CPR, what kind of CPR was performed, who applied the AED, and whether a shock was delivered. Detailed data after an AED is used should be made available to other healthcare providers such as emergency physicians and cardiologists.

What follows is a closer examination of why you need an AED registry:

- *You can't use them if you don't know where they are:* We know AEDs are extremely safe and effective.[2] We also know they are only used by the public in approximately 4% of OHCAs.[6] Knowing where AEDs are located and if they are being used is important information. For example, if AEDs are placed in a certain area of town but they aren't being used in cardiac emergencies, likely more public education is needed. In contrast, if cardiac arrest is occurring more frequently in a certain location where few AEDs are available, then more attention should be given to acquiring and placing additional AEDs throughout that community.
- *You can't use them if they're not maintained:* Just as an AED that is not found cannot save a life, neither will an AED that is not properly maintained. Maintenance includes making sure expired pads and batteries are replaced and software upgrades are installed. A Web-based AED registry can assist in ensuring the functionality of AEDs by sending maintenance reminders. Just as fire departments check fire extinguishers in a community, it makes sense that you need to have a system to ensure that all AEDs are maintained in a ready-to-use state.
- *You can't use them if they're not there:* Another reason for having an AED registry is the fact that the information can be useful in the submission of grants for the deployment of additional AEDs. To secure and receive either private foundation or government grants, a Public Access to Defibrillation (PAD) program needs accurate data—both utilization and patient outcome information. AED grants can come from both private foundations and government. An example of a private foundation offering grants is The Ramsey Social Justice Foundation (http://ramseyjusticefoundation.org), which has donated AEDs to communities participating in the SHARE Program in Arizona. An example of a government AED grant is the one offered through the U.S. Department of Health and Human Services' Rural Health program.

Finding AEDs with Social Software

Keeping tabs on the locations of existing AEDs has been a challenge. There have been several large-scale efforts to locate AEDs within communities. One such program in Philadelphia used a crowdsourcing approach. In 2012, the MyHeartMap Challenge (www.med.upenn.edu/myheartmap) set up a competition and offered monetary awards for those submitting the most AED locations. Using a smartphone application, participants photographed and recorded GPS coordinates for AEDs they found throughout the city.

Also using mobile phone technology, the PulsePoint App (http://pulsepoint.org) takes locating AEDs one step further—tying the location of the AEDs directly to nearby cardiac arrest incidents through the community's 9-1-1 system. The mobile app (iPhone and Android) sends real-time AED location information to those within a certain radius of a suspected cardiac arrest with the goal of increasing both bystander CPR and the use of the life-saving devices.

Potential lay rescuers must normally witness an arrest to take action. PulsePoint seeks to improve the efficiency of both CPR-trained citizens and publicly available AEDs by making bystander rescuers aware of cardiac events occurring nearby so they can retrieve an AED and begin CPR while paramedics are making their way to the scene. No one is in a better position to make a difference in the first few minutes of an OHCA than a nearby CPR/AED-trained individual. PulsePoint has been successfully implemented in many U.S. cities.

Disparity Issues: Location of Arrests

The location of a cardiac arrest has a significant influence on patient survival. Patients who arrest in public have a higher probability of having their arrest witnessed, receiving bystander CPR, and receiving defibrillation with an AED—all of which strongly increase the chance of survival.[2]

National data on bystander CPR and PAD programs have uncovered large and unaccept-

able disparities. For example, using the CARES registry, Sasson and colleagues found that in low-income black neighborhoods the odds of receiving bystander-initiated CPR was approximately 50% lower than in high-income non-black neighborhoods.[7] Their study showed that both the racial composition and the median income of a neighborhood have a significant effect on the likelihood of receiving bystander CPR. Studies like this help identify where to concentrate public training and education efforts.

In Arizona, Dr. Sungwoo Moon (a visiting professor from Korea University) found OHCA victims in mainly Hispanic neighborhoods received bystander CPR less frequently and had worse neurologic outcomes than those in mainly white, non-Hispanic neighborhoods.[8]

Using Geographic Information System (GIS) technology and SHARE Program OHCA event data, Dr. Moon was also able to identify the areas where OHCAs occurred most frequently but where AEDs were lacking. This is a great example of how important it is to have both cardiac arrest event and AED location data.[9]

A Variety of AED Registries

AED registries can take different shapes. Most states require reporting of AED locations to local EMS and/or dispatch centers. However, it varies widely as to how agencies capture and actually use this information.

Arizona's SHARE Program AED registry is voluntary; however, it fulfills the statutory requirement that AED owners enter into an agreement with a physician to oversee a PAD program. In the SHARE registry, medical direction is free of charge to those complying with the training and reporting requirements. The registry uses a Web-based data entry system.

AED owners must keep their units functioning and registries can play an important role in helping to ensure that AEDs are always in a ready-to-use state. A Web-based AED registry can send general reminders to registrants or targeted reminders based on expiration dates entered into the system. Several companies offer subscription services to assist with this.

The Future of AEDs

Tracking AEDs that are placed in static locations is one thing; however, tracking the location of AEDs that are mobile, such as those used during high school athletic events, requires a higher level of sophistication. Also, many AEDs are moved from one "permanent" location to another. In the future, AEDs will include technology (perhaps GPS, WiFi, Bluetooth, or other methods) that will allow tracking in real time, thereby allowing more efficient monitoring of the units' placement and readiness. This technology will likely be integrated into CAD systems in the future, aiding dispatchers in locating AEDs and relaying that information to callers, in an effort to increase AED use. And of course, more AED use and more bystander CPR will translate into more lives saved. ✚

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A simple motor vehicle crash can be used to visualize the "perfect EMS event"—one that brings together all of the complex EMS operations, clinical care and service delivery required for any patient scenario.

PHOTO BOB BARTOSZ

The "Perfect" EMS Event

What will it take to embrace the full potential of existing & developing technology?

By Greg Mears, MD

One of the best ways to visualize the future in EMS is to imagine what would happen if we combined all of technology in existence (or in development) today to describe the "perfect EMS event"—one that brings together all of the complex EMS operations, clinical care and service delivery required for any patient scenario. Let's give it a try ...

A motor vehicle crash (MVC) occurs. From the vehicle's automated crash notification system, dispatch receives the following information: the mechanism of the crash (low-speed front-end collision) and scene location; probability of serious injury (low in this case); number of occupants (two); and the occupants' baseline medical history (linked from personal medical records).

Dispatch identifies the closest EMS vehicle and electronically dispatches it to the scene with navigational directions. While EMS is en route, Emergency Medical Dispatch (EMD) is performed, identifying that the passenger is experiencing chest pain and is known to have coronary artery disease. The driver does not have any complaints. An existing 12-lead ECG is obtained from the patient's medical record and forwarded to the EMS crew en route.

Once the crew arrives on scene, they evaluate both patients. All data from their cardiac monitor, as well as voice recordings, barcoded information on procedures documenting the time and use of supplies (using RFID), and video from on-vehicle and helmet cameras, are automatically downloaded to the patient care report (PCR).

The driver is packaged as a "green trauma." The EMS crew obtains a 12-lead ECG from the passenger that indicates a STEMI (with left bundle branch block); they confirm that the new ECG is different than the baseline tracing from the patient's medical record. No injuries are noted.

The PCR software system is able to recognize the chest pain component as well as the abnormal ECG and recommend that the EMS crew consider administering aspirin as well as to recheck the patient's vital signs every five minutes. The software also identifies the closest PCI center and notifies the center of the incoming patient, while also forwarding the 12-lead ECG and activating the cath lab.

En route to the PCI center, information from the patient's personal medical record, crash detail from the automated crash notification system, all information associated with the EMS event, and real-time vital signs are transmitted to the receiving hospital. On arrival, the patient

is evaluated in the ED to ensure no significant traumatic injury was present before he's transported to the cath lab. A 100% LAD lesion is identified and reopened with a symptom-onset-to-reperfusion time of 65 minutes.

After the hand-off of the patient, all of the information from dispatch, medical devices, voice, RFID and pertinent personal medical information, as well as the care provided to the patient, are aggregated to create the PCR. The EMS crew quickly adds and adjusts the documentation based on feedback from the software. Once the PCR is complete, it's routed to the supervisor for review, to the hospital medical record system using the NEMSIS HL7 CDA, and to the EMS agency's same-day billing department.

After the patient is discharged from the hospital, outcome information is relayed electronically back to the EMS agency using the secure HL7 CDA and incorporated into the PCR system.

Weekly, monthly, quarterly and yearly reports based on performance measures and outcomes are also generated for the EMS agency and the regional area for review and performance improvement initiatives. Aggregate information is posted on community websites, highlighting the performance of the integrated system of care, including EMS operational and clinical care outcomes. Individual patient data from EMS is also linked with hospital, trauma, stroke, STEMI, cardiac arrest, airway and other registry systems to more critically evaluate the care provided to specific patient populations.

Ultimately, performance improvement processes are identified, including the need to consider medical conditions even when the EMS event appears to be traumatic in nature. This information is included in the next continuing education offering for both EMS and the ED.

Why Not Today?

All of the technology associated with the perfect EMS event exists today—so why are we not all using it? There are several reasons:

- Most EMS systems only have a portion of the technology described in place.
- The technology that is in place does not often integrate with other technology.
- The technology is not ready for this complete level of implementation.
- The infrastructure (such as Internet connectivity) isn't ready for this level of integration.
- Leadership at the IT, hospital and EMS levels are not ready for integration at this level.
- Devices and PCR software solutions across the industry in general do not use a standardized format; therefore, integrating data from multiple sources in a real-time fashion remains a challenge.
- Software is only beginning to engage in decision support to assist in the prevention of patient care errors, ensure protocol compliance and optimize EMS operations.
- Technology and its integration are expensive.

EMS agencies must look at their implementation from an IT and integration perspective. Devices and software are members of the healthcare team. Let's go through a brief overview of the device and software needs of an EMS agency with an eye on integration and optimizing operations and patient care.

Vehicles

Other topics within this supplement describe how data and technology can greatly impact and enhance dispatch, scheduling, education, etc. It's important to also consider the impact of the ambulance (or vehicle) itself. An EMS vehicle should provide a safe environment for the treatment and transport of both the crew and the patient, but should also serve as a center for patient care and the hub of our communications and technology.

Data coming into the vehicle should include dispatch and navigational information through a communications link. The vehicle also must have a connection to the Internet for data exchange. This can be accomplished through the development of a Wi-Fi hotspot within the vehicle that connects to the Internet through a cellular data modem. Other forms of connectivity, such as Bluetooth or radio frequency identification (RFID), may also be included.

The Wi-Fi hotspot can be created using a standalone solution within the vehicle, a built-in Wi-Fi solution within a vehicle safety product (e.g., Road Safety), or a solution built into a medical device (e.g., monitor defibrillator). Once the Wi-Fi hotspot is created, the existing software and devices that need to integrate and communicate can be connected. These include vehicle safety devices, cardiac monitors, defibrillators, central patient monitors, PCR software, supply inventory systems and other medical devices.

Externally, the Wi-Fi hotspot allows for the exchange of data between the central EMS data systems as well as hospitals, dispatch and other healthcare-related data systems and/or providers.

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The hub of information associated with any EMS event is the PCR.

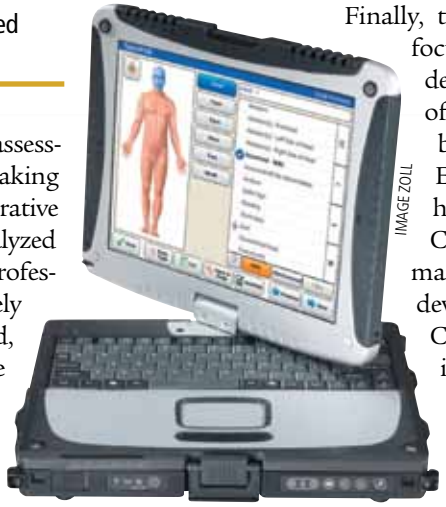
IMAGE ZOLL

professional in their patient assessment, treatment, decision-making and monitoring. It's imperative that the data collected, analyzed and presented to the EMS professional in the field be closely incorporated into the PCR and, when needed, relayed to the receiving healthcare facility.

This data exchange and movement should be based on existing standards, such as the National EMS Information System (NEMSIS) and HL7. (For more information on NEMSIS and HL7, see www.nemsis.org.)

There is an increasing interest in the EMS use of diagnostic devices from a laboratory measurement and imaging perspective. Examples include ultrasound imaging, measurement of cardiac ischemia and markers of sepsis. As these technologies come into commonplace use by EMS, their data and images must also transmit through this network and be included in the PCR.

Finally, there has been a significant focus on the outcomes of sudden cardiac arrest. The use of external CPR devices has become commonplace within EMS agencies. These devices have been shown to provide CPR equal to high-quality manual CPR. Many of these devices also capture data on CPR metrics and can transmit it into PCR and code review solutions. This data should be used to identify, measure and improve the resuscitation outcomes of cardiac arrest victims.

Clinical Decision Support

In the past five years, EMS has made tremendous progress in the resuscitation of the victims of out-of-hospital cardiac arrest (OHCA). This success has not been the result of a new intervention, device or medication. Rather, it is the result of a focus on providing *high-quality* CPR as opposed to just providing CPR.

This has been one of the many success stories where devices and technology have integrated with the provider to improve outcomes. Medi-

Real-Time Performance Monitoring

Technological advances have given EMS agencies an ever-increasing amount of data from 9-1-1, CAD, structured call triaging tools such as ProQA, and electronic patient care reporting (ePCR). Paradoxically, most EMS agencies now have less time and fewer resources to review this mountain of data to identify challenges and opportunities for improvement.

Two products designed to help agencies do just that: FirstPass, from the creators of FirstWatch software, and ZOLL's Insight Analytics. Both of these products allow users to track and benchmark their organizations across clinical, operational, managerial and financial metrics in near real-time.

FirstPass is a clinical measurement and protocol monitoring tool designed to alert users to deviations in expected treatments to medical protocols. It's a workflow-driven tool that is customizable and capable of operating in combination with FirstWatch tools anywhere there is Internet connectivity.

FirstPass provides continuous monitoring of ePCR to quickly identify and provide real-time alerts concerning protocol deviations, incomplete "care bundles," missing data elements or urgent patient safety issues. Users get a standard bundle of "protocols" designed to measure predefined quality metrics for STEMI, stroke, trauma, cardiac arrest and airway management patients. The protocols are configured with standard quality metrics, but the agency has the ability to add metrics specific to their locality.

The quality metrics are segmented into four components: system performance measures, clinical performance measures, patient safety/risk reduction performance measures, and financial performance measures.

Insight Analytics starts with industry-standard Key Performance Indicators (KPIs), but allows any user to create and publish customized new dashboards. The product is designed to help EMS leaders monitor and track performance improvement initiatives, compliance goals, cash flow, departmental protocols and productivity at a glance.

Users can compare their performance against similar organizations, then tap into a Facebook-style community to discover how others have solved similar problems. Up-to-date visual displays of current status and historical trends let users make immediate and informed decisions to improve quality and maintain compliance. Medical directors and EMS supervisors can track protocol compliance and quickly identify data outliers, see outstanding A/R status of billing claims, track department or employee productivity and quickly identify which trips were non-compliant and drill further into a call report to determine the cause.

cal devices, often attached to a monitor/defibrillator, can provide real-time feedback to EMS professionals, improving the quality of CPR and the outcomes of OHCA victims. The use of CPR quality software and devices are quickly becoming standard of care within the AEDs used by first responders and the lay public.

Beyond devices, PCR software is now capable (with FDA approval) to monitor the assessment, treatment and care of a patient in such a way that the software can provide patient safety recommendations as well as ensure that protocols are followed. This ability to guide or provide recommendations on the clinical care of a patient will increase as we move toward 2020. ZOLL is currently the only EMS PCR solution that has received FDA approval for this capability.

PCR Documentation

The hub of information associated with any EMS event is the PCR. The information making up the PCR is split between direct data entry by the EMS professional and electronic data from other sources.

The ultimate goal of any EMS agency is to maximize the linkage and use of electronic data sources while minimizing the amount of data that has to be directly entered by the EMS professional. The electronic movement of data into a PCR from an external source not only is more efficient for the EMS agency and the provider; it is also more timely, complete and accurate.

PCR solutions vary in their implementations based on the following features:

- Hardware and IT requirements, including whether the PCR is hosted on location of the EMS agency or a cloud-based Software as a Service (SaaS).
- Front-end user interface design, including ease of use, security and type of device (iOS, Android, Windows, etc.).
- Integration with medical devices, including monitor/defibrillator, 12-lead ECG, video cameras and others (ultrasound devices, glucose monitors).
- Integration with other software, such as dispatch/CAD, EMD and billing software.
- Data-analysis capability, including structured reports, user-configurable reports, performance improvement reports and outcome reports.
- Communication and messaging capability, including the ability to route documentation or alert EMS staff when certain events occur or when benchmarks or thresholds are hit (or missed).

IMAGE ZOLL

The information making up the PCR is split between direct data entry by the EMS professional and electronic data from other sources (e.g., dispatch, EMD, medical devices, other software data feeds).

- Export capability for entering information into the billing system, registries (CARES, trauma registry, etc.) and state systems (via NEMSIS).

Ultimately, each EMS agency must customize their ePCR solution based on the balance of the critical features noted above; integration with other data systems or devices; data analysis and messaging capability; ease of use and reliability; and cost.

No solution is perfect in all of these requirements, and it's critical to find a solution that fits your system's current needs and will evolve and grow as your EMS system embraces new concepts (e.g., community paramedicine).

Within Reach

Technology and data are key components of any EMS system. It is critical that EMS agencies consider medical devices and software as members of their patient care team. How data and technology is managed at the organizational, EMS professional and patient levels will determine the success and future of EMS. ✚

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From the Field to the ED

Technology exists to transform patient assessment, but standardization & regulation are needed

By Raymond Fowler, MD, FACEP

(Above) ECG transmission from ambulances—across an ECG transmission software platform—is possible currently, but differs among manufacturers. Standardization of ECG transmission technology is needed to fully realize the benefits of this technology.

It's mid-evening on a busy night, and the radio crackles in the emergency department (ED): "General Hospital, this is Rescue 80, on the scene of a 76-year-old woman with right-sided weakness and facial droop. Her speech is slurred, and she appears confused. Her last time to be known normal was about 45 minutes ago, when she said to the family that she didn't feel well and went to lie down. When they checked on her, they found her in the current condition. Her vital signs are: BP 175/90, pulse 88, respirations and pulse ox are normal. We are eight minutes from your facility or 25 minutes from the Stroke Center at Excelsior Hospital. What do you advise?"

And, so we face the current essence of EMS medicine: The critical care medic's assessment and field management skills are becoming more and more sophisticated. At the same time, the treatment of many critical care conditions is becoming more and more specialized. Combine the two, and suddenly a dilemma emerges: Would this little lady benefit from bypassing a peripheral hospital that might be pressed to give "state of the art" stroke care, for an extra 17-minute ride to a "stroke center"—while some 2 million brain cells a minute are dying in the ischemic focus inside her head?

EMS Medicine is the practice of medicine in the prehospital area. It is a subspecialty of medicine; the first physician certification examinations were offered in October 2013. With this step, EMS Medicine becomes a new member of the "House of Medicine." All participants in the process of patient evaluation and management

in the prehospital environment must strive to bring the best care possible into play.

Key to this progress: a vast increase in information transfer capability from the field. Electronic medical records—based strictly upon a federal data management and transmission standard authored in part by the principal author of this *JEMS* supplement, Dr. Greg Mears—now are the standard of clinical practice around which all patient care information is centered. Sophisticated EMS systems across the country and around the world now oversee trauma, stroke, STEMI, burn, pediatric, and soon-to-be sepsis networks to optimize the outcome of these patients. Time intervals in these patients are tracked closely: 90-minute symptom onset to arterial reperfusion for STEMI is a sought-after standard; soon, 60-minute door-to-thrombolysis windows for some 50% of patients who are victim of ischemic strokes will become the norm.

How then, in this increasingly complex technical infrastructure, can EMS systems play the dynamic part that they are destined to perform?

The Need for Standardization

When I started medical school in 1973, if a man came to the hospital having a heart attack, we would put him in the coronary care unit (which were just emerging at the time), treat his pain with morphine, give him oxygen, give him furosemide and digitalis if his lungs filled with fluid, keep him there for two weeks, and hope he wouldn't die.

Today, the acute coronary syndrome has emerged to be recognized as an acute arterial vascular emergency, the treatment of which is heavily based upon the role that EMS systems play in overall assessment and management.

And brisk progress has been made. STEMI networks have sprung up across the nation. The entire state of North Carolina is an organized acute cardiac care network. Dallas County (Texas) recently completed the organization of a county-wide STEMI network coordinating the care of patients with acute coronary syndrome across 25 EMS agencies and 15 emergency receiving facilities, with a common EMS-hospital linked dataset, uniform EMS protocols and uniform clinical pathways for hospitals. Uniform ECG transmission from all ambulances—across an ECG transmission software platform—has been achieved, and some of the treatment successes are staggering.

A generally standardized set of training programs and equipment exists in the prehospital phase through which all medical emergencies are managed. Training standards are found in federal guidelines. Equipment is generally similar from system to system, with variations induced by the marketing influence of manufacturers.

However, significant variations exist among the various producers of the spectrum of machinery and software used by many systems. For example, at least three different software methods of ECG transfer exist across the spectrum of prehospital care, resulting in the inconsistent ability of municipalities to provide for fully coordinated

Smartphones and tablets hold amazing promise for EMS, but for now, providers must be cautious when using this technology in the field, due to the potential to violate HIPAA regulations or FDA rules.

transmissibility across all platforms for ECGs within any single EMS system. The solution required is generally single-proprietary adherence of product across that given system. In this reality is the opportunity for improvement.

It is reasonable to anticipate that similar pressures that drove computer development—the "plug and play" generation of hardware and software progress across various computer and software makers—will drive similar progress in the realm of open architecture among the producers of ECG transmission technology. This would continue to streamline the free exchange of data across platforms in the provision of field patient care.

Telemedicine & EMS

Telemedicine is driving medical development in an accelerating manner. *Example:* Tele-neurology, in which a neurologist evaluates a stroke patient remotely, is now considered a normal part of stroke assessment and treatment. Tele-

All participants in the process of patient evaluation and management in the prehospital environment must strive to bring the best care possible into play. Key to this progress: a vast increase in information transfer capability from the field.

ICU monitoring has also emerged, allowing critical care nurses and physicians to monitor the status of patients from off site in a safe, prompt manner.

EMS telemedicine has emerged more slowly. It is interesting to watch a re-run of one of the old *Emergency!* shows and watch the live transmission of the patient's rhythm to Rampart Hospital. One would have thought that by now, some 40 years later, the streaming of patient information on a live platform from the field would be customary. I recall well the live-streaming waveform on the old Motorola screen in a small ED in eastern Georgia as I discussed the case with the medics in the field.

Vital sign "pushes" in a non-real-time manner are available from equipment producers, giving vital signs updates as frequent as every minute. This availability requires a proprietary software platform. Another manufacturer provides high-quality Web-based audio, video and monitor information to the local base station.

Smartphones & EMS

It's interesting to wonder when EMS will capitalize on the technology provided by a typical smartphone. Excellent quality audio and video could be sent to the base station in a very inexpensive manner, allowing the medical direction team to hear and see the patient. This would seem very appropriate in the setting of the evaluation of a stroke patient, for example. The assessment of infants, of accident victims, of burn patients, and of other cases would also seem to benefit from this process. And patients refusing transport could be videotaped and the records filed for medico-legal purposes.

One has to be cautious, however, with the application of new software and devices directly into the stream of patient care, as opposed to "after the fact review" within a quality management program. The FDA has a direct role in the approval of items that fall within the evaluation and management of a patient, requiring what is called a "510K Clearance." A recent article by a medical student in a prominent newspaper asked, "Will your next physical be done by smartphone?"[1] However, it says almost nothing about the smartphone participating in the direct line of patient evaluation from a critical care perspective.

Thus, at this time, EMS providers should be cautious about using any sort of audio and video devices directly in the line of patient care. An example of this would be calling the hospital and sending a video of the patient directly to a receiving device, most likely another smartphone, through which a provider at the ED, such as an emergency physician, would then make a treatment decision. It theoretically might not be allowed under FDA rules, and it certainly has the potential for a HIPAA violation with regard to patient privacy.

The Evolution Continues

Advancing EMS opportunities, such as the community paramedic effort sweeping the world, will dictate the need for continuing to improve the communication resources between providers. Optimizing what can be assessed on the scene, providing the care in the field that is based on best evidence, and linking up appropriate providers to assist in management while preparing hospital-based facilities where indicated, will continue to evolve as patient needs, provider skills and technology development lead us. ✚

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Reference

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PHOTOS ZOLL

A Seamless Exchange

Standardizing processes & sharing data across the healthcare continuum is key to improving quality

By Mic Gunderson & Greg Mears, MD

(Above) Electronic patient care report (ePCR) systems have been shown to improve billing and collections and facilitate mandatory data submissions to state and national EMS data repositories. However, the ePCR systems in most EMS organizations fall far short of their full potential to facilitate improvements in patient care.

EMS systems exist to provide high-quality care to the patients we serve. Therefore, one of the major goals of a state-of-the art EMS data system is to help ensure that the care you provide is meeting your standards; another goal is to help improve that care over time. In this article, we look at what's on the horizon for clinical quality assurance and improvement and how EMS systems are using data to integrate with the rest of with the rest of the healthcare system.

Standardizing Process & Outcomes Measures

Electronic patient care report (ePCR) systems have been shown to improve billing and collections, facilitate mandatory data submissions to state and national EMS data repositories, and allow for instantaneous answers to a wide variety of on-the-fly questions that previously took several hours or even months to complete, depending on the number of reports that had to be accessed in file drawers full of paper patient care reports.

However, the ePCR systems in most EMS organizations fall far short of their full potential to facilitate improvements in patient care. The weak link has not been so much in the design of the ePCR data collection software or hardware, but in the *reporting*. In the past, most of the reporting features provided by software suppli-

A health information exchange allows EMS agencies, individual physician offices, hospitals and clinics to share records on the same patient.

ers have tended to focused on billing and activity reports. The activity reports on the clinical side typically include pre-configured reports on metrics such as the numbers of responses, number of medical procedures or medication administrations, success rate percentage for medical procedures, percentage of responses with transports, and response-time intervals.

These reports, although good, don't directly address the goal of using data for clinical quality assurance. To be clear, clinical quality assurance in EMS is the overall process used by an EMS provider organization and/or regulatory agency to ensure that clinical care meets applicable standards.

One of the major obstacles is configuring the reporting features of the ePCR software in a way that compares care delivered to the applicable standard(s). Because every EMS system can have different standards, developing such reports has been a huge barrier.

Progress is being made, albeit slowly, on developing standardized measures of process and outcomes performance. Protocols are typically built around the ideal for how a process should be carried out (e.g., cardiac arrest, STEMI), but the goals of the process remain the same even if the standards differ.

Example: In cardiac arrest, the outcome goal is patient survival without long-term neurological or other functional damage. One of several process goals, addressed in the design of the protocol, is to minimize interruptions in chest compressions. The applicable standardized *outcome measures* for cardiac arrest are found in the Utstein criteria for out-of-hospital resuscitation.

The standardized *process measure* for chest compression interruptions is the compression fraction—the percentage of time that compressions were actually performed during the time the patient was pulseless. The local standard in one EMS system may be a compression fraction of more than 70%, but it may be more than 90% in another system. By standardizing the process measures, each system can set its own thresholds and use the same metrics to monitor its performance on individual cases and in aggregate for the entire EMS provider organization or EMS system.

As the EMS profession matures in its use of quality management, and as the Centers for Medicare and Medicaid (CMS) increases the use of pay-for-measurement and pay-for-performance strategies, more and more process metrics will become standardized and required nationwide. How much an EMS provider organization

gets paid by CMS may vary with its use of applicable clinical process performance metrics.

We see this in hospitals with "core measures." Hospital that do not track and report their core measures get paid less. Among those hospitals that track and report their core measures, the ones that show better outcomes on their core measures get paid more. CMS has stated that core measures will be coming to all aspects of healthcare it pays for—including EMS. The only question is when. Accountable Care Organizations (ACOs) will also be looking for such metrics and the accountability they bring from their EMS system partners.

If we have processes in place to measure our clinical performance against our standards for quality assurance purposes, we have much of what we need to facilitate quality improvement.

In this context, quality improvement in EMS is the overall process used by an EMS provider organization and/or regulatory agency to *change* processes with the intent of getting better outcomes. This may be in terms of process outcomes (e.g., better compression fractions); better patient outcomes (e.g., higher survival rates); better operational outcomes (e.g., shorter task times); or better efficiency outcomes (e.g., lower cost to get the same process, patient or operational outcomes).

The current level of process performance is assessed using applicable process and outcomes performance metrics. Here is where standardized process and outcomes measures come to the rescue again. Statistical tools are used to compare the control group results with the experimental gtoup results and determine the likelihood that the difference was not the result of simple chance.

This raises the bar for our software tools, the people designing them, the people using them and the people interpreting the results. Our EMS software tools will need the ability to add in modules or updates that utilize standardized process and outcomes metrics. As more metrics are developed and as existing metrics are refined, the software will need to keep up.

The vocabularies of best-practice EMS organizations will be expanding to include terms like dependent, independent, extraneous and confounding variables; statistical significance; statistical power; statistical process control and control limits; and user specification limits. These terms are central to the methods used by top-performing improvement programs and must be among the skill set of whoever you purchase data collection software from.

Obtaining Outcomes Data from Hospitals

Even if we have standardized patient outcome measures, they do little good if we cannot access the outcomes information from the hospital we brought our patients to. This has been a huge barrier in many EMS systems. The good news is that hospitals are being asked by payers for process and outcomes data and to show improvements over time to maximize their revenues (i.e., pay for performance). This is now limited to a handful of core measures, but will be growing very quickly with the implementation of ACOs and associated incentives.

The typical pushback from hospitals when EMS agencies ask for outcomes data relates to *privacy concerns*. This is a bogus argument. The real issues seem to be more related to the time and effort that hospitals have to expend to give EMS the data it wants. Now that the hospitals have some motivation (*requirement*) from the payers and hospital accreditation bodies to look at the whole continuum of care and need EMS data to help their own improvement efforts, their resistance has been diminishing.

One method for obtaining outcomes data is based on manual queries. For example, an EMS agency might ask a hospital for the outcome and some event time data for cardiac arrest, STEMI or stroke patients. In the request, the agency would have to include some information to allow the hospital staff to look up the patient record in their hospital medical record system.

The problem: Protected health information (PHI) is usually needed, such as patient names, dates of birth, addresses, etc. Sending PHI back and forth via email creates security risks. Encryption or other mechanisms may be needed to address those concerns and keep the whole effort compliant with HIPAA and other regulations. Common workarounds include crews recording a hospital chart number on the EMS report, or doing the queries over the telephone or in person to avoid having PHI exchanges in writing.

So long as the volume of such queries is small, manual methods can work. For larger EMS systems and hospitals, however, this approach may require dedicated staff time—and expense.

A complicating factor to consider is when the EMS data set needed for quality assurance or improvement purposes involves more than one data system or more than one organization. Inside a single EMS provider organization, clinical process metrics may require information from the ambulance communications center, which may not be integrated with the ePCR data and therefore requires a process to

pull data from both sources and place it into a separate file.

Alternatively, the data from multiple sources can be linked using relational database systems from which queries and reports can be generated. If more than one organization is involved, such as a 9-1-1 center, a medical first-response provider and an ambulance provider, the process becomes complicated.

The databases you may want to query or link to are often out of any one organization's control. Like the hospitals, this requires organizational cooperation. Also like the hospitals, that's much more likely to happen if all organizations with needed data have an interest in the performance metrics or share accountability for quality assurance and improvement efforts.

To minimize the labor on the hospital side, some EMS systems rely on getting copies of data the hospital has already collected for its own internal purposes. For example, if the hospital's cardiac catheterization laboratory participates in the ACTION Registry for acute coronary syndrome cases, the data that EMS is interested in—and that the hospital typically needs from EMS—are all included in the ACTION registry data set (www.ncdr.com/webncdr/action).

Because the hospital has already made the queries to enter their information into the ACTION registry, EMS agencies can help provide their data, and then both entities can share the completed data sets for patients they mutually cared for. Similar approaches are possible for stroke and other cases where registries are utilized.

Ideally, all of the organizations involved in the continuum of care participate together on standing quality assurance/improvement committees and collaborate on ad hoc quality improvement project teams.

Electronic Data Exchange

The downsides of getting outcomes and process data from multiple organizations are obvious in terms of time, expense and hassle. The newest approaches use software to help the process and outcomes data move between organizations more efficiently. There are two primary methods to accomplish this: *data file interoperability* and *health information exchanges*.

Data file interoperability uses a standardized data format to send and receive information between provider organizations. Health Level 7, a Standards Developing Organization, developed the HL7 Clinical Document Architecture (CDA) standard (www.HL7.org). This standardized format is recognized worldwide for interoperability of health information technology.

The National EMS Information System (NEMSIS) has worked with HL7 to develop a NEMSIS Version 3-specific CDA to promote the exchange of EMS data with hospitals and the rest of the healthcare industry.

Using this approach, EMS provider organizations send a file of data elements in the specified format to the hospital. The information is used to place a copy of the EMS PCR into the hospital's medical records system.

In return, software on the hospital side can be programmed to send a compatible file back to the EMS agency containing the outcomes information for the patient after they leave the emergency department (ED) or are discharged from the hospital. The NEMSIS Version 3 HL7 CDA has been successfully implemented in two hospitals through a collaboration between ZOLL Data Systems and the NEMSIS Technical Assistance Center.

A more robust approach uses an intermediary computer system called a *health information exchange* (HIE). Think of an HIE as a data "middleman" that attaches to the computer systems in one or multiple organizations, providing a portal for each organization to search and retrieve information on patients across all of the participating organizations. Multiple hospitals and groups of individual physician offices or clinics that participate in an HIE can share records on the same patient—to obvious advantage. If EMS is included in the HIE, sharing data back and forth for continuity of care and quality assurance/improvement is readily accomplished.

The HIE infrastructure includes appropriate security controls so individuals and organizations can only access the information they're authorized to (e.g., ambulance services are only able to search and retrieve data on their patients).

Imagine a process that queries the 9-1-1 communications center, the medical first-response provider, the ambulance provider and the hospital to assemble all of the data needed on an episode of care and then generates specified reports and pushes them out to designated recipients—automatically. That's the power of an HIE.

Healthcare System Integration

Almost every effort to improve the efficiency and effectiveness of healthcare delivery involves healthcare integration—smoothing out the rough spots when a patient transitions from one organization, or care unit within the same organization, to the next. The many rough spots in those transitions are the source of untold

numbers of problems and enormous costs.

Most healthcare system integration issues are related to data. *Example:* The 9-1-1 communications center gets a call. Somehow, it needs to pass the caller and whatever information it collected to the medical first-response agency dispatcher and/or the ambulance dispatcher. One of those dispatch centers may be the provider of emergency medical dispatch services to perform medical triage and give pre-arrival instructions to the caller. Some of that information must be passed along to the responding crew(s). That's a transition point with several potential rough spots. If the medical first responders arrive first, they will gather information as they make their initial assessment and begin care. When the ambulance arrives, the information must be passed along to them—another transition point and lots of other potential rough spots.

And so it goes, from the ambulance to the ED to the specialty-care units (e.g., cardiac cath labs, trauma center, stroke center, ICU, etc.) to the general wards to the attending physician(s) and to any rehabilitation services.

The software tools to manage data across the transition points are just one element of healthcare integration. Healthcare system integration also involves the same patient in multiple care settings on multiple occasions.

A well-integrated healthcare system would allow each provider at each transition point to have access to pertinent information in real time. *Example:* A call is made to 9-1-1 and transferred to medical first responders and the ambulance service. They both can access pertinent information on prior calls to the same patient. They might also see alerts ("do not resuscitate" orders, or other advance directives) that are important to know *before* making patient contact.

In this model, the crews would also be able to access the patient's past history, medications, allergies and emergency contacts. When considering the right destination, they would consult information on the in-network hospital and its ability to care for the patient's current condition. If the patient is low severity, perhaps they don't go the ED. It may be best to make an appointment for follow-up with their family physician or specialist. This starts to engage the processes of care commonly discussed in community paramedicine programs. The value and utility of an HIE to facilitate healthcare integration is what's likely to make them popular as the economic benefits and regulatory mandates to do so increase.

The Possibilities Ahead

The gathering of healthcare data can make it possible to do things we could only imagine in the past. Consider the HIE being able to look at data on a diabetic patient from 9-1-1, medical first response, physician offices, EDs, hospital specialty-care units, general wards, and rehabilitation facilities. It would be possible to spot dangerous trends that would never be detected by any other means and alert the patient and appropriate care providers to allow intervention sooner—with better outcomes and at a lower total cost.

And consider looking not just at one patient, but an entire community. Trends may be spotted to detect the emergence of geographic or time-associated patterns of disease or injury.

We see the very basic elements of this type of trend detection capability in syndromic surveillance software systems used with public health data and emergency medical dispatch data.

The bottom line: Technology can and will do amazing things for the treatment of individual patients and the advancement of mobile integrated healthcare. We have a long way to go before the systems that need to communicate seamlessly can do so, but the promise of better care at lower costs should compel each of us in EMS to strive for standardization of process measures, sharing of data with all organizations within the healthcare continuum, and the development of reporting tools that help us use this data to its greatest potential.

The data is out there—it is up to us to figure out how to share and use it. ✚

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Beyond Traditional Response

Mass gatherings and other large-scale events create a strain on any EMS organization. The ability to collect data and quickly apply it can help mitigate issues and allow organizations to be more prepared to meet the demands of the event.

EMS data use in mobile integrated healthcare, mass gatherings & MCIs

By Jeff Beeson, DO, FACEP, EMT-P, Michael Potts, CCEMT-P, & W. Heath Wright, BA, LSSGB, EMT-P

EMS systems have data, mountains of data. Most, however, are unsure how to use it outside of fairly standard resource deployment and clinical benchmarking. Often, the problem is data integration. Healthcare is delivered by many different providers in different locations. These are often described as spokes on a wheel, with the patient being the center, or hub. As the patient rolls down the street, the spokes themselves are weak, but when aligned and supported by the rim, they become part of an equalized, strong machine.

While the development of electronic health records has brought new focus on the need for integration in healthcare, most EMS electronic record systems continue to be episodic. They have limited ability to query their database and pull records from previous experiences. The result is another spoke.

In fact, the data gathered by EMS systems has a much larger potential. Three key areas where EMS data should be used are integration of mobile healthcare delivery, mass-gathering events and mass-casualty incidents.

Mobile Integrated Healthcare

If you haven't heard the term Mobile Integrated Healthcare Practice (MIHP), you've probably at least heard the term Community Paramedicine. The concept of utilizing EMS personnel in non-traditional roles is not new. In fact, some communities have been doing it for decades. The Affordable Care Act has simply accelerated this development. As a result, EMS systems are questioning the longevity of their current deployment styles. The days of "you call, we haul" are ending.

Although many systems want to establish a MIHP, they're often unsure of what they hope to accomplish. The first step should always be a needs assessment: Analyze the data. Utilize the expertise of public health programs to identify gaps in the delivery of healthcare in your community. EMS data includes location and types of calls within an area. Hospitals and health providers have data on their patients and types of visits. EMS providers that do inter-facility transports have additional data of where patients are moving through the healthcare system. These systems must talk to each other and allow EMS agencies to learn the final patient outcome and be a true partner in the healthcare system.

Data collection, storage and retrieval are becoming extremely important in the dispatch discipline of EMS systems. In addition to real-time notification of critical information to responders, EMS agencies can use this information to analyze previous calls. Such analysis may lead you to identify the need speed up or slow down response to specific calls, and/or send different resources. And it can be done on individual addresses or phone numbers or general geographic areas. Identifying multiple occurrences of the same activity or type of response is a great way to reveal volume increases with geographically significant patterns.

Many MIHP programs begin with a focus on high utilizers. Every community has a population that frequently utilizes EMS or the emergency department (ED) for primary care needs, no matter how many times we direct them to appropriate care. What would happen if we spent the time to find out *why* these patients return? A simple needs assessment can be performed by reviewing EMS and hospital data to identify historical trends.

Community resources are the backbone of a MIHP. Most communities have a number of different types of agencies, medical providers, service systems and ancillary programs—additional spokes in the wheel. Separately, their data is utilized to provide the specific service(s) they focus on, but communication between these entities is often lacking. Imagine if the individual programs worked together and shared their data. As a *community* of resources, the possibilities expand.

At MedStar in Fort Worth, we hold a monthly "meeting of the minds." Social workers from hospital systems sit at the table with community mental health workers and folks from meal-delivery programs, homeless coalitions and religious organizations. The purpose is to share data. When each individual "spoke" has knowledge of the others, the patient can be navigated to programs that meet their needs. In many communities, there is unused capacity in these programs—but often, it goes unrecognized. When all the various resources meet, the individual organizations access their own data and create an in-person data exchange with others. Although not very technical, it has become the greatest asset in our MIHP. It is simple integration.

A simple starting point is to capture the address and or phone numbers of individuals identified in the needs assessment, a service provided in the 9-1-1 infrastructures in most systems. When dealing with CAD, this is known as ANI (Automatic Number Identification) and ALI (Automatic Location Identification). The number (or residence) can then be tagged in the CAD with specific information—specialized medical equipment or needs, appropriate responses, etc.

You can also tag a specific location as a known area that may have dangerous activity, such as a drug lab or area with violent patients or history of previous domestic violence calls, which can automatically initiate a police response along with medical personnel. In the MedStar system in Fort Worth, we flag addresses where an AED is on property. In the event one is needed, the 9-1-1 call-taker can direct the caller to its location. We also flag individuals with specific healthcare needs, including patients with home ventilators, ventricular assist devices, or those with emergent medical needs. In addition, we flag hospice patient addresses so that when the family calls 9-1-1, we can notify the hospice providers.

In 2009, we began our needs assessment by reviewing CAD and electronic medical record data. We identified specific addresses and patients who utilized 9-1-1 frequently. We went into our community to locate these patients. We assessed their needs, both medical and social, and then connected them with resources in the community. Many of the patients had issues with mental health, drug addiction and basic understanding of navigating our healthcare system. Most had transportation needs.

Our MIHP started with our EMS Loyalty program. We identified a need to better respond to, manage and navigate this subset of the population within our healthcare system. We worked with community resources to create a plan of care for these individuals. We flagged their addresses in the CAD, and worked with our hospitals to create notifications in their electronic health records to identify these patients. The result has been an integrated healthcare delivery that has decreased the 9-1-1 and ED use in this popula-

tion. They are getting better healthcare with better outcomes, and in a more economical setting.

Mass Gatherings

Any time a few thousand people get together for an event, incidents are going to happen. Mass gatherings create a strain on any EMS organization; in fact, the strain is often felt throughout the entire healthcare system. Issues from traffic congestion to lack of resources provided by the event promoters create significant concerns for EMS systems. The ability to collect data and quickly apply it can help mitigate these issues.

Many resource deployment tools and needs assessment calculations exist for mass gathering preparation. If the event has occurred before, data on types and numbers of patients handled is available and should be used in planning. The type of event, environmental exposures and expected participants will each have an effect on how busy the EMS provider will be. A NASCAR event will have a much different crowd than a symphony concert in the park.

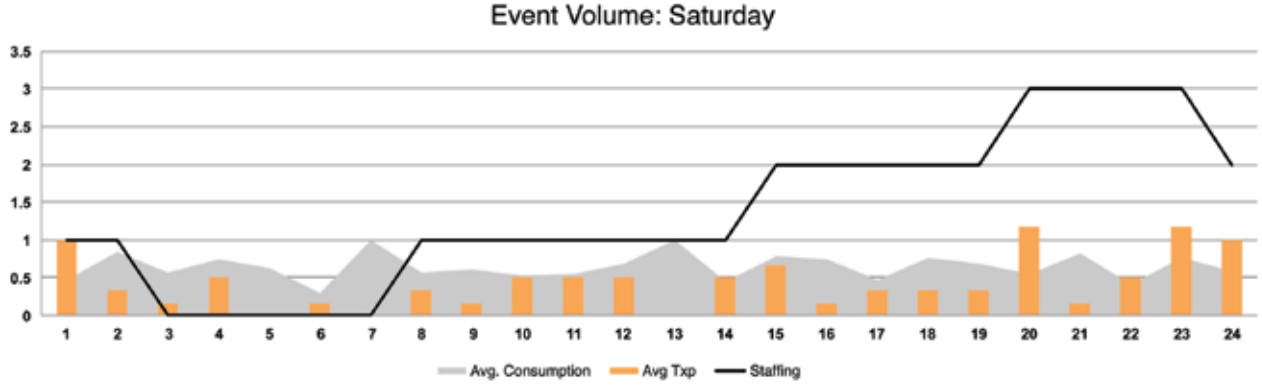
Planning is the key. Software applications, such as FirstWatch, can monitor current system performance, while processes, such as PULSE (Performance, Utilization, Lost unit hours, Special Events & Excellence) can help evaluate previous and future system performance. Deployment simulation software systems such as MARVLIS can model the potential impact the mass gathering could generate on system demand. These types of programs also allow a service to make changes to the system in a simulated environment, so planners can see the effects.

Working with the venue operators, promoters and local public safety and healthcare organizations allows an integrated approach for response. You should understand how traffic will be diverted and where first aid or treatment areas will be located. By utilizing the similar concepts of unified command, all responding organizations can easily communicate available resources and known events and seamlessly share data.

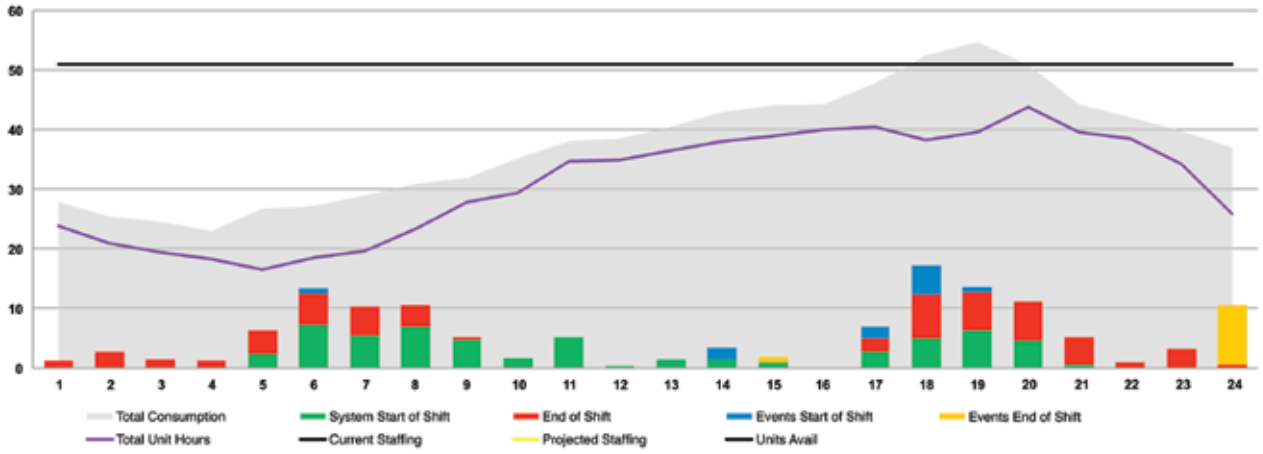
After-action meetings and reports are also a significant source of data. By discussing what worked well, and where future changes should be made, organizations can improve the services they provide. These reports also become data elements that can be shared with others.

The Texas Motor Speedway in Fort Worth is a NASCAR venue where all of our data comes together. With attendance in the tens of thousands, this venue becomes a city within our city. We have more than 15 years of data from previous NASCAR races and other events held at that location, and we use it to work closely with the venue, promoters, on-scene medical teams, fire responders and police to ensure the attendees and sponsors have a good event. MedStar utilizes the MARVLIS software to show the shift in geographical demand during the week of the events.

Our PULSE process allows us to review previous events and preview expected system delivery, such as unit hours scheduled, time shifts in peak call volume and resource utilization, then create a staffing plan for the event. Weather forecasts are evaluated to determine any changes needed in our plan. During the event, our unified command, on-scene supervisors and system controllers utilize FirstWatch to monitor continuous system performance and make needed changes to staffing and posting locations based on call volume. We monitor our receiving hospital's status on Web-based data systems to ensure even distribution of patients to appropriate locations. Data allows us to not only prepare, but also shift the system rapidly if unexpected events occur.



This graph illustrates the call volume an event creates and the staffing to cover the demand. The consumption area in the background includes the time it takes for the unit to complete the call and the time it takes to return to the event.



This graph shows the amount of resources used in the system and any dedicated mass gathering. This allows for Logistics and/or Fleet to increase staffing in advance to mitigate an increase in workload. The unit consumption is based on the time a unit is in service or being prepared by Logistics for the next shift.

Mass-Casualty Incidents

When buses, multiple cars or mass gatherings experience problems, they are usually big ones. The simplest definition of a mass-casualty incident (MCI) is when the number of casualties overwhelms the available resources. One of the most important pieces of data at an MCI is the ability to track patients. Patient tracking applies in several different areas of EMS, including MCI evacuation/relocation, mass-gathering events and sheltering locations.

Web-based patient-tracking tools can integrate with EMS patient care reports and hospital medical records. Recent versions integrate tracking numbers or barcodes from scene triage tags. Having a Web-based tool gives the entire incident team the ability to obtain information, deploy resources, track movements and develop plans.

Once an incident is created, a series of preplanned events occur. When a scene size-up is entered, automated alerts notify hospitals and require them to update their bed status. EMS responders then receive the bed status reports to help formulate a plan for transporting patients to appropriate receiving facilities. As patients are triaged, and transportation is assigned, the software will track movements via the unique identification number. Once a hospital has been assigned a patient, they can view the type and numbers of patients that are inbound and prepare to receive them.

Hospitals acknowledge electronically that they have received each patient, allowing the incident commander to continuously update their patient count and assign resources more appropriately. This system-wide integrated approach provides real-time data to those responsible for decision-making to allow for better tracking of resources and patient movements during the event.

Such technology maked patient tracking easier and more accurate for field providers and receiving facilities. Web-based applications are great tools for the providers working the incident, the emergency operations center monitoring the incident, and receiving hospitals determining what their demand will be. Continuous data is a key to successfully managing an MCI.

It's What You Know

Data should drive most things in EMS. How it's applied is limited only by the minds of those who choose to use it. As EMS transitions into more healthcare delivery, the non-traditional uses of data will become more important. As a partner in the healthcare system, our significance will only be recognized when we reveal what we know. In any setting—from MIHP to mass gatherings to MCIs—that recognition comes from our data. ✚

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Show Me the Money!

EMS is a business, like it or not

IMAGE KERMIT MULKINS
ALL OTHER PHOTOS/IMAGES COURTESY ROB LAWRENCE

By Rob Lawrence

This section of the supplement is about the EMS business and the systems that support it. No, it's not! Deep down, it's about the *money*—making it, and, importantly, *using it* to achieve great patient outcomes.

In these cash-strapped times, I encourage every EMS leader to adopt the Richmond Ambulance Authority (RAA) fiscal philosophy: At RAA, we say we have a "bucket of money." If we submit complete, correct and billable call sheets, we fill the bucket. If we use personnel hours wisely and don't crash the trucks and take care of the equipment, we will use some of the cash in the bucket, but we will also have sufficient reserves for such things as newer, cooler equipment—and even pay raises. Put a hole in the bucket of money, however, through bad or poor practice, and the first things to go are the nice things.

The bottom line: Running your EMS system like a business is an absolute necessity, especially in the current political and fiscal climate.

When we think EMS data, we automatically think response and intervention—the machines and monitors that spew out information to improve the next rotation of care. But EMS systems can only be successful if they have the right amount of appropriately qualified providers, in enough correctly maintained vehicles, loaded with sufficient amounts of equipment, with the means of recording the patients' history and demographics, to generate a fee for service, to fund the next turn of the response cycle.

All of these seemingly mundane functions create the conditions that enable EMS to physically happen and are the power behind the punch of service delivery. All require enormous amounts of attention to detail and most directly affect the bottom line. System efficiency can only occur if prudent leaders develop an understanding of a devil's amount of detail in these business areas.

In fact, the definition of the "quality unit hour" is simply two fully trained medics in a fully equipped vehicle for one hour. The unit hour is in fact a unit of currency because everything costs something. Unless that unit hour is deployed wisely, no income can be obtained.

Scheduling: The Most Important Asset

In any organization, EMS or otherwise, staff are the most important *and* the most expensive asset. Too many staff on duty for the level of call volume means unit hour utilization falls. Although crews may have a more relaxing day in that situation, cash hemorrhages from the organization.

So, scheduling the right amount of staff on duty is a critical financial activity. Before anyone is placed in a shift, a detailed demand analysis must occur to deliver the amount of unit hours needed for each day of the week (see graph below). Once the accurate demand forecast is known, then the placing of staff into shifts, stations or vehicles can begin.

The simplest scheduling systems include the basic sign-up sheet where volunteers identify their availability or the Excel-type spreadsheet systems that calculate hours worked. At the upper end of the spectrum, Web-based, interactive specialist software systems allow management to easily manipulate and extract information in a cost-effective manner.

A useful piece of technology developed in-house at RAA, with the cooperation of our scheduling vendor, is the ability to overlay demand analysis with the actual staffing on any particular day. The combination of these two data streams allows managers to see where "pinch points" or operational pressures will develop and facilitates getting the right amount of people on duty.

Billing: The Birthplace of the Budget

Medical billing is an entire industry in its own right; and it's critically important to EMS organizations. Many dyed-in-the-wool veteran providers, however, don't give a second thought to what happens after the call sheet has been completed and "sent to file."

Assuming the department actually bills for service (and most services now do), the bill is the birthplace of the budget. This year's income determines next year's spend, just as last year's activity informs you of this year's demand. Accurate report completion provides the billing department the best opportunity to correctly categorize the bill into the appropriate fee for service.

In addition, data analysis around the patients served, and bills generated, does more than just indicate potential income. The payer mix, once identified, provides a clinical cross-section of the population served; by understanding the Medicaid, Medicare or private-pay status of those served, managers can better understand the return on billing.

Example: No EMS system achieves a 100% income on the fees charged. The Medicare rate may be less than the bill, or local insurance carriers—particularly in the Affordable Care Act era—may not pay all that is expected. Analysis of both payer and the entity that pays out must be understood to identify the return on bills sent.

A thorough understanding of your billing *time* is also key. Knowing how quickly bills issued result in money back to your organization also assists in setting the budgetary tempo. Considerable analysis by both billing and finance staff as to the solvency this income brings determines the rate of service delivery.

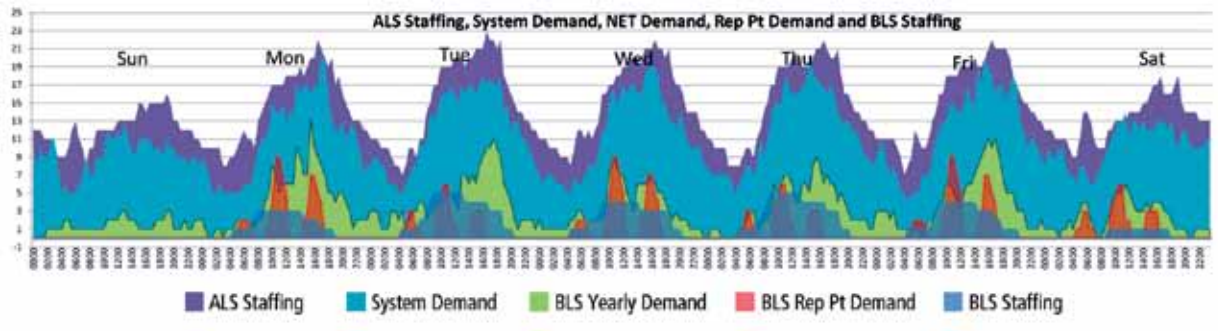
Paid bills are the cash that fills the mythical bucket, so understanding billing data becomes a critical requirement. Just as response times or ROSC stats are important for the operational team, so is billing data for the admin team.

Vehicle Maintenance: Catch It Before It Fails

Preventive maintenance is the only way to ensure the patient never has to wait any longer than necessary for an ambulance, or worse, wait in a broken-down ambulance on the side of the road for a replacement vehicle to arrive.

Data is as much a key requirement in caring for vehicles as a toolbox full of wrenches. In many states, comprehensive vehicle records are a permitting requirement, and they're certainly a "must have" to attract any form of formal accreditation, such as that awarded by the Commission on Accreditation of Ambulance Services.

Vehicle maintenance records provide evidence of failures and their frequency. They can reveal



Data is as much a key requirement in caring for vehicles as a toolbox full of wrenches.

equipment trends and inform maintenance or replacement decisions. For instance, if you can identify when key components break on a particular type of equipment, you can design a service or replacement plan to take care of the problem before the equipment fails.

The term "unscheduled maintenance" is code for cash hemorrhage. If a truck and its crew have to leave the street with zero notice, unit hours (EMS currency) are wasted. The net effect is one less vehicle available on the street when the carefully constructed, data-driven demand analysis says you need them.

Poor maintenance, then, potentially equates to poor patient service and a reduced revenue stream. Use of a data system and the establishment of a "mean time between failures" (MTBF) chart for key equipment and abiding by it will ensure that unscheduled maintenance remains at a minimum. This alone will pay for your investment in a vehicle maintenance data program.

Many types of maintenance tracking systems exist in the marketplace, but consideration should be give to systems that capture:

- *Assets:* Your vehicles by their VIN and type.
- *Retired assets:* Keeping data on old vehicles and vehicle types allows for comparative analysis against new or updated units.
- *Work orders:* Who did the work (one mechanic may fair better at a repair vs. another). Also, a record of parts used on every truck allows for cost-benefit analysis of the relative worth of a vehicle, particularly as they near end of life and determinations need to be made about disposal or continued service.
- *Preventive maintenance:* Maintenance is the "public health" program for vehicles. A sufficient understanding of other fleet metrics will allow the timing and intensity of servicing to be adjusted to ensure a cost-effective level of treatment.
- *Inventory:* Understanding inventory, both what is on the shelves and what has been fitted to the vehicle, informs stock control.

Supply Management: Money Management

Let's face it, EMTs and medics are hoarders. In environments where stations have their own running stores or the same crews look after the same vehicles day in, day out, there's a tendency to "add" equipment to the vehicle because "you never know." This might seem like a good idea, but there is a high probability that it will lead us to purchase more equipment and supplies than we need, only to watch it expire and be disposed of—the equivalent of throwing cash straight into the dumpster.

The key is to have a system that accounts for stock and identifies both fast-moving items (so you can ensure that sufficient levels are maintained) and slow-moving items (so you can ensure that such items are rotated to vehicles or stations that will use them before they expire).

Your data system should also analyze the *frequency* of equipment used. *Example:* The use of an expensive item, such as an IO needle, can be tracked against clinical activity to confirm that the expenditure of such high-dollar disposable equipment is appropriate. The RAA system identifies where and when high-cost items are used to ensure that they're not being employed where a more cost-effective device could be used.

Data and usage assessment also minimize equipment *storage*. The adoption of a "just in time" system means that only a few days of stock is stored on site and regularly circulated onto the trucks. An item of unused stock on the EMS store shelf is money that could be used for a better patient outcome elsewhere or increase your earned interest on those dollars.

In terms of logistics management, there are now a number of data-related products in the marketplace that will track, monitor and even locate pieces of equipment. Radio frequency identification (RFID) systems communicate with an electronic reader mounted in your ambulances to identify the presence of an item of stock or part. RFID can also be used to identify new stock arriving into your agency's "store" location and load it into the stock-management system; after the item is loaded onto the truck, RFID records its location, and the inventory status is updated.

Key pieces of equipment, such as expensive

monitors, stretchers, stair chairs, suction units and first-in bags, can also be fitted with RFID chips and programmed to alert the crew if the vehicle moves away from the allocated device. If a piece of equipment is inadvertently left on scene, it will send an alarm before the crew get too far away, allowing them to retrieve it—clever stuff!

The same RFID system can also help you clinically monitor when the equipment leaves the vehicle to ensure that monitor and suction units leave the ambulance as the crew arrives at a cardiac or unconscious patient call. This helps ensure that cardiac patients are not walked down two flights of steps and out to the ambulance before being monitored or suctioned.

UPC (universal product code) bar coding is another stock-control system that is seen everywhere from supermarkets to the bottom of the computer this article was typed on. Code readers write to a database, which assembles stock control and is then able to report information trends, usage and expenditure.

The key to EMS supply management is to have a system that accounts for stock and identifies both fast-moving items (so you can ensure that sufficient levels are maintained) and slow-moving items (so you can ensure that such items are rotated to vehicles or stations that will use them before they expire).

Education & Credential Management

How quickly would your organization make it to the front page of the local paper if one of your providers made a mistake and then it came to light that they weren't even certified or up-to-date on the particular skill that caused the issue in the first place? How much more egg on the face would there be if management had no idea that said EMT or medic was not current or actually qualified to do the job? I can hear the litigation cash register "kerchinging" as I type!

Information technology systems abound with databases to capture employee credentials and manage them for you. Some products are even capable of generating email reminders to the provider *and their supervisor* that qualifications and certifications are nearing expiration.

This notification system is especially useful and cost effective in larger departments, where it can be difficult to track requirements for a large number of personnel. Although it should always be the provider's responsibility to remain current, the system can monitor who and what is expiring or up for renewal. This can save you from a lawsuit and that equates to big dollars.

The RAA system, for example, counts down a provider's time to certification or credential expiration. In the worst-case scenario where something expires (good management should prevent this, of course), the employee "clock-in" system, which is integrated with the credentialing system, refuses to allow the provider to book on-shift. With the plethora of required courses and state-mandated training providers must maintain today, a system that not only captures data, but also sends alerts, is the only way to go.

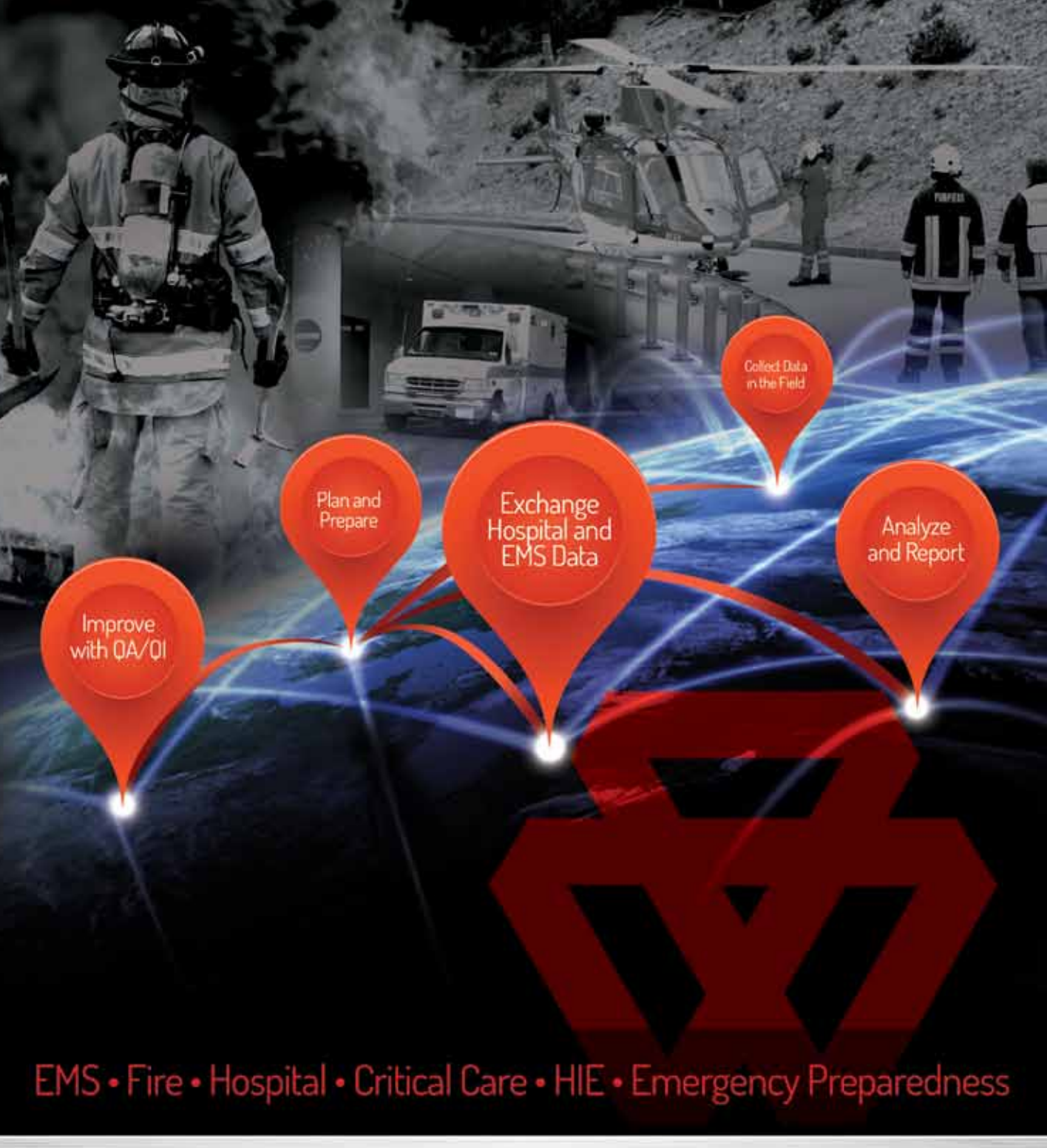
The Last Word

This section of the supplement appears last for a reason—not because it's the least sexy of the topics, but because readers must be left with the lasting impression that EMS is a business, and we need to run it as such.

Knowing our business means understanding every possible metric out there, even in the back office. And this applies to every type of EMS agency: Not-for-profit organizations need money to make payroll; volunteer organizations need money to buy equipment; in the public sector, the days of bailouts and bottomless municipal coffers are a thing of the past; and in the private sector, failure can lead to new ownership before you can say "hostile merger and acquisition."

Put simply: The consequences of not paying attention to the "business side" of the business are dire. ✚

Rob Lawrence, MCMI, is chief operating officer at Richmond Ambulance Authority and was named a JEMS *EMS 10: Innovator of EMS for his work on the Rider Alert program in 2011. Lawrence is a graduate of the U.K.'s Royal Military Academy, Sandurst, and spent his first career as an active-duty Army Officer in the British Royal Army Medical Corps, after which he held various senior leadership roles in U.K. ambulance services before moving to Richmond, Va. to join RAA.*



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