

# Order Out of Chaos: Emergency Department Integration Software

Mark Daniel Olszyk, MD, MBA, CPE; Gary Tyndall, MD; and David Gelman, MD

The Veterans Health Administration has developed a software system for emergency departments that interfaces with the electronic health record system to increase awareness, streamline flow, enhance communications, and augment safety. These authors describe the historical development of the software, including the need, the circumstances of its development, and its implementation.

For as long as there have been emergency departments (EDs), there has been a need to keep track of patients and their status. For most of that history, EDs have made due with racks of paper charts with a flag system, dry erase boards, chalkboards, or some combination. Although worn through overuse and often illegible, dry erase boards present a low threshold to entry, incur minimal capital expenditures, are virtually maintenance free, and are intuitively easy to operate. However, as emergency medicine (EM) becomes evermore concerned with patient flow, efficiency, and analyzing care delivery, it is clear that a better method of tracking patients

and care delivery is required. An optimal system would give data that yielded long-term, high-level, or in-depth views of all aspects of ED patient flow. Department chiefs cannot rely on intuitive or anecdotal knowledge about which patient care steps (eg, laboratory processing, clinical decision making, or inpatient bed acquisition) create the largest delays. They need hard data that can be analyzed and dissected. A dry erase

board cannot meet those demands, because the data are captured only temporarily, in 1 instance, and in 1 location. Data are prone to error, because the board is not *smart* and has no built-in fact-checking capabilities. Finally, and most important, data are lost as soon as they are erased. This runs counter to the Veterans Health Administration (VHA) culture of improving care by capturing essential performance-related

---

**Dr. Olszyk** is senior medical officer in the Office of Quality, Safety, and Value in the VHA and former chair of the VHA Emergency Medicine Field Advisory Committee in Washington, DC. **Dr. Tyndall** is the chair of the Emergency Department at the Syracuse VA Medical Center in Syracuse, New York, and the national director of Emergency Medicine in the VHA in Washington, DC. **Dr. Gelman** is associate chief of Emergency Medicine at the VA New York Harbor Healthcare System in New York, New York.

The VHA's Specialty Care Services includes medical services with a wide range of subspecialties; emergent and urgent care and patient support services, such as nutrition; spiritual care and other specific-purpose programs, such as cancer registry and Centers of Excellence for multiple sclerosis, epilepsy, and Parkinson disease. The Office of Specialty Care Services brings you "Updates in Specialty Care," sharing the latest evidence-based approaches, each column featuring a different topic and providing updates on existing programs, and introducing new programs. Special thanks to Margaret (Maggi) Cary, MD, MBA, MPH, director of the VA's Physician Leadership Development Program, who coordinates and edits the column. Please send suggestions for future columns to [margaret.cary@va.gov](mailto:margaret.cary@va.gov).



data and using the knowledge gained from that data for improvement initiatives. The impetus for VHA Emergency Medicine is to replace the traditional whiteboards with a digital representation of patient flow, track the arrival of the patient in the ED to his or her eventual disposition, and then analyze all those steps individually or in aggregate to learn more

*Emergency departments require an application that can harness the strengths of the CPRS but remain nimble enough to be responsive to the needs of a busy clinical environment that cares for multiple patients in parallel.*

about the dynamics and challenges of ED operations and thus provide evidence and analytics that suggest improvements.

The VHA is recognized as having one of the best electronic health record (EHR) systems in the world, the Computerized Patient Record System (CPRS).<sup>1-3</sup> Because the bulk of care in the VHA is outpatient primary or specialty care, the health record reflects the origins of need that gave rise to it. The records system is geared toward primary care physicians seeing 1 patient at a time. It provides a great depth of information about any 1 patient, but it lacks the agility to navigate quickly between patient records that emergency providers require in their world of parallel care delivery. It also records data, laboratory values, narrative encounters, and the like but not the time segments between discrete points of care. Thus, it is more like a collection of high-quality still photographs, not the movie that would assist Monday-morning quarterbacks and coaches to dissect and analyze the coordinated team sport that is EM. Emergency departments require an application that can harness the strengths of the

CPRS but remain nimble enough to be responsive to the needs of a busy clinical environment that cares for multiple patients in parallel.

There existed several options to obtain this intelligent patient tracking system: (1) Buy a program off the shelf and in use by private sector EDs; (2) Contract with a developer to write the code for a tailor-made solu-

tion; and (3) Explore a do-it-yourself option. Option 1, the licensing of a commercial off-the-shelf (COTS) product, would seem the easiest but was fraught with potential hazard. Most COTS products came as a suite of products and not as an à la carte program. Because VHA already had a robust EHR system, buying a commercial system that bundled patient tracking and EHR functionality would result in an unnecessary expense. Prior health technology projects undertaken by VHA demonstrated difficulties ensuring support of a COTS product over its entire lifecycle. Also, integrating an outside product with the CPRS was not always straightforward. Option 2 also presented a challenge: Many developers were not familiar with the code in which the CPRS was written and if not internally managed, any change in the CPRS would result in the need to upgrade the interface and perhaps the ED tracking system itself. This is not an easy feat if the original developers had moved on to other projects. There were also a myriad of competing projects, each with strong arguments for precious resources and better track records to attract

the confidence of leadership. In the end, developing an in-house solution seemed the right decision and, in retrospect, the only decision. The Syracuse VA Medical Center was the cradle of the Emergency Department Integration Software (EDIS) project, where local developers worked directly with clinicians and programmers to create the software.

Forward thinking ED directors across VHA heard of the locally created software and clamored to bring it to their departments. At first, there were only a few test sites, and each proved instrumental in further refining, debugging, and improving the software. But within a few years, EDIS rolled out to the entire network of 146 VHA EDs and Urgent Care Centers (UCCs) nationwide, tracking more than 2 million ED and UCC visits annually.

Current EDIS functionality supports the following needs: (1) improved awareness through real-time display of patient flow, including number of laboratory and radiology tests pending or returned; (2) reporting for VHA use and for outside organizations such as the Center for Medicaid and Medicare Services (CMS); (3) improved care by providing providers with data to evaluate their efficiencies of care; (4) standardized workflow across the many VHA emergency care sites; and (5) future implementation, in concert with the CPRS, of decision support and clinical pathways.

### **IMPROVED AWARENESS**

EDIS's primary benefit for ED staff is that it has good situational awareness. Most EDs do not offer a universal and clear line of site of the entire department from every vantage point. Most do not even allow an unobstructed view of the existent whiteboard. However, EDIS can run

in multiple locations and provides the same view in each location. Real-time patient status displays on both large screen monitors and desktops, enabling staff to maintain situational awareness and identify bottlenecks in patient flow. The large monitors can be as big as the physical environment allows. Patient data that are available for display include patient identifiers, triage-level room assignment, status, provider and nurse assignments, order status, free text comments, and elapsed minutes from first contact. This information makes it much easier to locate a patient by name, diagnosis, or bed location. High-alert tags help staff to identify patients with the same or similar names, and configurable color codes allow identification of special populations (eg, active-duty military and pediatrics).

The improved awareness extends beyond the ED. Because the data and patient status are electronic, the information board can be replicated anywhere. Phlebotomists in the laboratory can see whether there are any orders simply by glancing at the screen. Nurses on the wards or in the ICU can scan the board to look for potential admissions. Administrators and bed control officers can keep tabs on flow and clinical operations. As a result of these key features, EDIS has become a key component in a smart hospital management system.

Direct storage in VHA patient databases allows for seamless access to records and provides opportunities for robust reporting and analytics in support of rational resource allocation, forecasting, and preparation for exigencies. Data available for review and analysis can be organized and ordered by any of these data, as well as by diagnosis and disposition. EDIS generates time stamps created by software interaction representing key events during patient evaluation

and care, which can be used later for patient flow analysis, such as identification of common delays or obstacles to discharge.

As Mark Smith, MD, and Craig Feied, MD, pointed out in a paper published by the New England Complex Systems Institute, the emergency care setting (being a complex system) is often resistant to simple changes causing predictable outcomes.<sup>4</sup> They argued that the key to improving such a system is to provide information about the system itself. *Sunshining* critical information can be all that's needed to nudge a complex system in such a way that it improves itself. Smith and Feied went on to say, "By making process information public, people tend to act so that the information reflects favorably upon them." One example of this is sunshining personal productivity. Prior to EDIS, ED physicians could only

measuring ED length of stay for admitted and discharged patients, as well as bed delay (the time from admission decision to ED departure) for admitted patients. Prior to EDIS, reporting these intervals of care would have been impossible. Local reports can be generated from EDIS data. National reporting capabilities are currently being developed that will use data accessed from a central data repository. The reports will yield information on daily department activity, provider productivity, patterns in patient presentation or diagnosis, missed opportunities, bed availability, and variation of workload throughout or between days, weeks, and months.

### IMPROVED CARE

EDIS contains simple tools for safety and privacy. It provides a visual warning on the display boards

*Unlike a whiteboard where anything can be written, display of patient-related information can be confined to data fields that do not include free text, thereby reducing the possibility of displaying sensitive material regarding a patient's symptoms or diagnosis.*

evaluate their work based on billing data or how many patients they saw over time, possibly broken out into intensity by CPT codes. However, EDIS allows for real-time tracking of productivity by allowing a clearer means for providers and nurses to compare their current and historical performance with that of their peers.

### REPORTING

First and foremost, EDIS addresses the reporting requirements for measures of an ED's throughput. The VHA implements several performance measures. The CMS is currently in the review process for

when 2 patients in the ED have the same last name. When new patients are added, EDIS uses the same algorithm as the CPRS to alert users of patients with similar medical record numbers or last names. This reduces the likelihood of choosing an incorrect patient. The use of flat-screen displays makes patient information more readable and eliminates the issues of legibility of the prior whiteboards. Unlike a whiteboard where anything can be written, display of patient-related information can be confined to data fields that do not include free text, thereby reducing the possibility of displaying sensitive ma-

terial regarding a patient's symptoms or diagnosis.

### STANDARDIZED WORKFLOW

As soon as EDIS was running in more than 1 ED, it became clear that there was not a common language among ED staff. Seemingly unambiguous terms like *admission*, *discharge*, and *delay* were all locally defined and had different triggers, connotations, and associated processes. Subcommittees were chartered to define common nomenclature for the ED. These terms were hardwired into the EDIS vocabulary with very strict definitions. Although the software is locally configurable to allow departments to reflect an accurate representation of their department, the terminology is

lowers access to data and order entry directly from the graphical display screen, thus eliminating unneeded steps. Every improvement has been suggested or implemented with simplicity in mind. Every minute saved in the ED means more time for patient care. In the interest of safety and better data analysis, future versions of EDIS will have flags or icons for high-risk patients, gender, age, and information, such as veteran vs active-duty military status.

Mindful that EM providers and staff are constantly on the move, future versions of EDIS will be configured for mobile platforms, such as tablets, smartphones, and handheld computers, which will finally free staff of the bonds of the nurses'

*Mindful that EM providers and staff are constantly on the move, future versions of EDIS will be configured for mobile platforms, such as tablets, smartphones, and handheld computers, which will finally free staff of the bonds of the nurses' station or dictation room.*

fixed. Additionally, reasons for discharges or delays were made finite, so whether data are aggregated from 1 site or from many sites, common clusters will emerge. This allows VHA ED staff to speak a common language and thus communicate process improvements and best practices even outside of EDIS. Prompts may also appear to remind a provider to enter the reasons a patient has exceeded some predetermined length of time. These prompts can be set nationally so that all sites are reporting the same metrics in the same way.

### FUTURE PROJECTS

The second version of EDIS is currently in testing stages. It navigates more quickly and easily to the underlying CPRS architecture. It al-

lowers access to data and order entry directly from the graphical display screen, thus eliminating unneeded steps. Every improvement has been suggested or implemented with simplicity in mind. Every minute saved in the ED means more time for patient care. In the interest of safety and better data analysis, future versions of EDIS will have flags or icons for high-risk patients, gender, age, and information, such as veteran vs active-duty military status.

lowers access to data and order entry directly from the graphical display screen, thus eliminating unneeded steps. Every improvement has been suggested or implemented with simplicity in mind. Every minute saved in the ED means more time for patient care. In the interest of safety and better data analysis, future versions of EDIS will have flags or icons for high-risk patients, gender, age, and information, such as veteran vs active-duty military status.

type decision support tool, Stroke Quality Improvement Decision Support System. When completed, it will remain as an icon on the triage nurses' desktop screen. As soon as a patient presents to the ED with a concerning symptom, a prompt on EDIS will trigger the pathway or will suggest that the pathway be considered. Once activated, the pathway will present a comprehensive series of assessments and orders designed to reduce the time from presentation to definitive therapy. For many in the health care industry, the mantras of "time is muscle" and "time is brain" are well-worn saws, but clinical pathways built into the ED software bring the promise to accelerate care, minimize errors, and build in recommendations from up-to-date clinical evidence and literature. Pathways for cardiac conditions, gastrointestinal hemorrhage, burns, poisonings, and other conditions that frequently present to the ED will soon follow.

Future applications that will leverage the efficiencies and quality extended by EDIS are real-time location systems (RTLS), graphical user interfaces for mobile devices, and corporate data warehouse matrix management. VHA has many concurrent projects to evaluate the adoption and integration of RTLS. Initially used at a few VHA sites for tracking specialized equipment, the RTLS paradigm of using wireless sensors to track movement in space is starting to enter the patient care arena. In the ED, RTLS will reduce the data entry burden on clinicians. This will greatly increase the accuracy of time points associated with patient or provider movement, for instance, the time of first contact with a physician or the time a patient spends outside the ED in radiology. Defining the vision and scope for RTLS use is a difficult process; however, achieving a

unified vision across all hospital departments, let alone across all VHA regions, will be necessary to allow for interoperability of these systems and use of the captured data. The procurement and implementation of an eventual solution will be harder still.

Some of the benefits of EDIS were not even imagined before its construction. Research is ongoing to evaluate whether triage data collected from EDIS can be used in a prediction model to estimate the number of admissions that are likely given the current patient mix in an ED. The large geographic scope of the data captured by EDIS makes syndromic surveillance for outbreaks of respiratory and gastrointestinal pathogens or even screening for toxidromes related to chemical or biological terrorism possible.

## SUMMARY

The VHA EDs have made great strides in the past 5 years, adopting standard nomenclature and pro-

cesses, increasing patient safety and staff awareness, and collecting data in a way that lends toward modeling and prediction. Many, if not most, of these gains have been realized directly from EDIS or from the work involved in its development and deployment. Future versions will be even more functional and adapted to the rigors of EM. The VHA supports one of the largest networks of EDs in the world, and EDIS can be credited with improving the care of millions of veterans and their families when they most need it. ●

## Author disclosures

*The authors report no actual or potential conflicts of interest with regard to this article.*

## Disclaimer

*The opinions expressed herein are those of the authors and do not necessarily reflect those of Federal Practitioner, Quadrant HealthCom*

*Inc., a division of Frontline Medical Communications Inc., the U.S. Government, or any of its agencies. This article may discuss unlabeled or investigational use of certain drugs. Please review complete prescribing information for specific drugs or drug combinations—including indications, contraindications, warnings, and adverse effects—before administering pharmacologic therapy to patients.*

## REFERENCES

1. Evans DC, Nichol WP, Perlin JB. Effect of the implementation of an enterprise-wide Electronic Health Record on productivity in the Veterans Health Administration. *Health Econ Policy Law*. 2006;1(pt 2):163-169.
2. U.S. Department of Veterans Affairs. VA Receives 2006 Innovations in Government Award. U.S. Department of Veterans Affairs Website. <http://www1.va.gov/opa/pressrel/pressrelease.cfm?id=1152>. Published July 10, 2006. Accessed August 27, 2013.
3. The Best Medical Care in the U.S. Bloomberg Businessweek Magazine Website. <http://www.businessweek.com/stories/2006-07-16/the-best-medical-care-in-the-u-dot-s-dot>. Published July 16, 2006. Accessed August 26, 2013.
4. Smith M, Feied C. The Emergency Department as a Complex System. New England Complex Systems Institute Website. <http://www.necsi.edu/projects/yaneer/emergencydeptex.pdf>. Accessed August 26, 2012.

### To our readers of this special issue:

Kindly help! Please give us your valued feedback. Take our brief online survey at <https://www.surveymonkey.com/s/FedPracAugSuppStudy>.



Or, scan the QR code with your smartphone or tablet for direct access to the survey. Thank you in advance for your input!

