Analytics in Healthcare

How the healthcare industry will uncover the real value of electronic medical records and the emerging electronic health record (EHR) initiative

The Power to Know®

A SAS White Paper

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Executive summary

Electronic medical records (EMRs) and electronic health records (EHRs) hold great promise to improve the efficiency and quality of patient care while reducing cost and errors. The development of standard data models and a standard lexicon for coding patient care — coupled with government endorsement for a national healthcare information infrastructure — is accelerating the transition to paperless practice.

For all its promise, though, there are drawbacks. Electronic record-keeping systems are expensive. Physicians are hesitant to change their work habits. Until everybody adopts electronic methods, the truly paperless healthcare environment remains a pipe dream.

Even when that point is reached, EMR and EHR systems alone will not offer up all of the benefits that they should. These systems will automate transactions, support research and make records more accessible, but will they answer elemental questions about the quality of those patient interactions?

- What treatment regimen yields the best outcomes for patients with this genetic profile?
- What insidious drug interactions are we likely to see in a patient with these risk factors?
- How well does this combination of therapies help patients undergoing this procedure?
- What protocol produces the best rehabilitation results for this target population?

To answer questions such as these, clinicians and researchers need business intelligence (BI). Their administrative staff have been using BI for years to run the business better. Now, with new sources of digital data about patients and their clinical experiences, BI is being applied to improve not just medical practices, but the practice of medicine.

The near-term evolution is already exciting. Traditionally, medicine focused on diagnosing and treating existing conditions, with limited data links across the continuum of care. In the emerging stage of data-powered healthcare, predictive analytics are being applied to reduce errors and to improve outcomes — incorporating new data sources such as genomic data and digital diagnostic images. The logical extension of this evolution is *personalized medicine* — holistic, pre-symptomatic treatment focused on preventing conditions rather than treating them after the fact.

The common denominator for these evolutionary stages is data — the ability to gather, cleanse and analyze extremely diverse data, without having to be a statistics guru.

The good news is that the technology is here today.

So, bring on the evolution and press EMR/EHR systems to deliver the *real* return on investment that they can.

The paradoxical state of healthcare technology

No question about it, modern-day health care is a technological marvel.

Microscopic laser pulses reshape the human cornea to restore perfect vision. Magnetic resonance imagery and computerized axial tomography show us intimate details of living tissue, even the human brain. Robotic systems with tiny cameras and instruments perform delicate microsurgeries. Sound waves create three-dimensional images of unborn babies. Artificial hearts made of titanium and plastic sustain the lives of humans after their natural hearts have failed.

But darned if you can find the chart for a new patient being transferred from the satellite clinic… Or decipher the scrawled prescription… Or get a complete history on the patient who can't remember.

"It is astonishing that, in a time when computers enable businesses to manage and locate everything from dry cleaning to used trucks, few healthcare providers are able to access and track the medical records of patients across the continuum of care," wrote Charlene Marietti, editor of *Healthcare Informatics*.[1] "Most large acute care providers are aggressively tackling the electronic medical record deficiency, but providers in thousands of solo and small office practices, where the majority of care is delivered, show little progress toward that goal."

An electronic medical record (EMR) is a computer-based record of patient care. EMRs have the potential to enhance the efficiency of every aspect of the patient experience, from scheduling appointments to managing patient care to reporting and billing. A computer-based record has the advantage of being accessible from multiple locations via a secure network. Providers can have ready access to medical histories, lab test results, digitized diagnostic imagery and reference databases — wherever they are.

No one disputes the potential value of standardized EMRs. Study after study reveals that electronic medical records can improve care and reduce costs. The projections are enough to make a hospital administrator salivate: promises to eliminate more than 2 million adverse drug events and 190,000 unnecessary hospitalizations a year… to reduce medication processing time by 68 percent and problem medication orders by 58 percent… to trim 10 percent from the nation's $1.7 trillion a year healthcare bill… or as much as $400 billion saved per year, depending on whom you ask.

Why, then, is 60 percent of hospital "paperwork" still actually on paper? Why is only 15 percent of clinical data stored in digital format? Why does North America lag so far behind other developed countries in the adoption of electronic records?

"Although multiple stakeholders, including the government, insurers and even consumers, are pushing this change engine, the disadvantages continue to outweigh the advantages for the majority of private practice physicians," Marietti wrote. "It isn't a question of technology. Physicians aren't Luddites. They own and operate some of the most sophisticated equipment and devices in the world."

But even now, a half-decade into the new millennium, the deterrents seem to outweigh the benefits:

Change is expensive. An EMR system for a large hospital or healthcare network can cost $10 million or more. A system for a smaller clinic or group practice can cost $10,000 to $20,000 per physician. And that's just for starters. Ongoing operating costs can add another 25 percent per year.

Any change, even positive change, is a burden. "Many physicians recognize the potential of EMRs but remain sidelined by the extreme difficulties they foresee on every path to adoption," Marietti wrote. Many physicians simply prefer paper-based processes to electronic ones. Even if they don't have a bias, they know how disruptive it will be to change their work habits and move thousands of pages of paper records into electronic files.

The paperless practice is ultimately a long-term vision. "Even physicians who do have EMRs cannot fully realize their return on investment until the majority of practices are computer-based," Marietti noted. A team that adopts an EMR may enjoy internal efficiencies, but until everybody uses the technology, staff will still have to grapple with paper coming in from clinical departments, specialists and other clinics. They may even have to add staff to scan and enter all of that paper-based information into new computer systems.

So until very recently, EMR remained a good idea bogged down by lack of standards and market acceptance.

The eight core elements of the IOM data model

1. Health information and data
2. Results management
3. Order entry/order management
4. Decision support
5. Electronic communication and connectivity
6. Patient support
7. Administrative processes
8. Reporting and population health management

Promising trends for adoption of electronic medical records

The last few years have seen several trends that are accelerating the adoption and value of EMR:

Government endorsement. In July 2004, the U.S. Department of Health and Human Services (HHS) announced a 10-year plan to create a new National Health Information Infrastructure (NHII), including an EHR for every American and a new network to link health records nationwide. According to then HHS Secretary Tommy Thompson, the initiative "will provide a quantum leap in patient power, doctor power and effective health care."

A standard health record model. HHS commissioned the Institute of Medicine (IOM) to design a standard EHR model for the healthcare industry — working with Health Level 7 (HL7), an American National Standards Institute (ANSI)-affiliated standards organization. This initiative gave rise to the EHR Collaborative, a broad-based consortium of public and private-sector healthcare organizations, which generated data models for IOM approval. A national EHR standard — as part of the NHII — will enable effective data sharing among all stakeholders.

Standard language. A standard model needs a uniform language. That goal got a huge boost when the National Institutes of Health National Library of Medicine signed a five-year contract with the College of American Pathologists to license SNOMED-CT (Systematized Nomenclature of Medicine — Clinical Terms). The contract provides universal access to a machine-readable, clinically rich lexicon for standardized coding.

Better mobile computing options. Some physicians still shun computers, but more of them than ever are embracing handhelds, tablet PCs and laptops. That's no surprise, since every year mobile devices get faster, cheaper and easier to use. EMR software is getting more mature and user-friendly, with interfaces that accommodate more diverse practice patterns. Wireless networks are growing ever more reliable and affordable, with better coverage. The critical pieces of the EMR technology puzzle are falling into place.

Growing market acceptance. In a recent member survey by the American Academy of Family Physicians, more than 80 percent of respondents said they had investigated acquiring an EMR system. Granted, most of them still don't have the technology, but their willingness even to window-shop is encouraging. Perhaps the trend represents a generational shift, as younger physicians emerge from tech-intensive medical school programs. Maybe it's the natural result of improved technology options. Or perhaps it's simply a logical response to fiscal pressures; healthcare providers are tasked to do more with less and technology is proving to help.

Early signs of positive results. Clinicians are moved to action when they see the difference these systems make in patient care delivery. EMR ultimately is about improving the practice of medicine and enhancing the workflow of physicians and their interactions with patients, administrators and researchers. As providers start to see the benefits, we will see a groundswell in adoption of EMR technology.

EMR and EHR — There is a difference

The two terms are often used interchangeably, but they do have different meanings:

- An **electronic medical record (EMR)** is a computer-based medical record of a patient's activity within a provider organization. This record may incorporate outside data, such as that from labs and referring specialists, but the EMR is generally focused on activity within a single provider. The record is typically owned and controlled by the provider organization and used to support transactions and access across that organization.
- An **electronic health record (EHR)** operates at a much higher level. An EHR contains a lifetime record of a patient's medical history across many provider organizations and technology platforms. In the vision set forth by HHS of a national EHR data store, this record is owned by the patient, who grants access to providers.

Provider-centric EMRs feed into patient-centric EHRs. However, the real promise of these records will be seen when EMRs are integrated with practice-management systems and EHRs are integrated with research systems to support evidence-based healthcare delivery. More on that later.

Will EMRs and EHRs be the blockbuster prescription?

Or will they just automate transactions and generate more data?

The widespread adoption of EMR systems (and in turn, a national EHR database) will no doubt be a boon to efficiency and effectiveness. Healthcare organizations can save time, reduce costs and improve processes by automating patient care transactions, such as appointment scheduling, medication orders, lab tests and billing.

However, these benefits only begin to scratch the surface. Transactional EMR systems will only go so far in delivering ROI. Alone, these systems will not provide the insights that would enhance the quality of patient care and the practice of medicine in general.

In short, there may be more data than ever, but will it truly be answering stakeholders' needs?

- Clinical investigators and research administrators need to track outcomes with more reliability and thoroughness than general clinical practice, while satisfying institutional review boards and the new NHII framework.
- Regulators and financial backers need assurances that studies have adhered to rigorous methodology, appropriate legal frameworks and guidelines for safety and efficacy.
- Clinical managers wonder, "How can I accurately investigate patient and clinic data over time to improve the overall quality of patient care and make the best operational decisions?"
- Public health officials and pharmaceutical companies need to know how clinical research results relate to large populations and other studies in the entire research domain.
- Clinicians are asking, "Can I have faith in the research reports that I read and the implications they hold for modifying my treatment plans?"
- The public is asking, "Are decisions about our medical care based on the best possible evidence and advocacy?"

The answers lie within mountains of clinical, research and practice-management data. Unfortunately, this data lies buried in a labyrinth of disparate systems and databases that are neither integrated nor fully utilized.

The current mode of operation in many healthcare organizations doesn't provide very effective answers to these questions, or provides them at very high cost and with dubious accuracy. Even as standards start to take hold at the national level, there are practical, local impediments that make it difficult to gain the necessary insights:

- **Different types of data.** Even when clinical data is available in digital form, it is usually formatted for billing purposes rather than for analysis. Furthermore, there are several entirely different categories of data to deal with: EMR data that relates directly to patient care, aggregated data about organizational performance and resource utilization, statistically derived data for planning and decision support and comparative data for research and outcome assessment.

Some of this data is episodic and patient-focused, some is cumulative over time, entities and populations. Data elements and coding strategies vary among specialties, such as MedDRA for recording adverse events and ICD-9CM for coding diagnoses for reimbursement.

It's a challenge to reconcile and cleanse all of this incompatible data, much less reap useful intelligence from it.

- **Incompatible platforms.** Traditional healthcare information systems typically reflect a process- and patient-oriented view of the business. The architecture uses a host of independent systems on different platforms, which share information in a limited way, if at all. As growth, mergers and acquisitions reshape information networks, it's common to see multiple, incompatible platforms even within a single functional area.

To realize the *real* value potential of EMR/EHR, the industry needs a more holistic approach — the ability to combine EMR data with other types of data (lab, financial, operational, research, etc.) and analyze it to reveal the hidden knowledge it contains about trends and opportunities. This calls for "business intelligence" and data analysis.

"The use of business-intelligence and data-analysis software in the healthcare industry isn't new," said Rick Whiting in a special Healthcare Enterprise edition of *Information Week*.[2] "Such tools have been a mainstay on the financial and administrative side for a decade or more."

Whiting continued: "Until recently, however, business-intelligence technology hasn't played a big role in delivering care. That's changing as healthcare companies build data repositories with information culled from operational systems used to record patient admissions and discharges, bill patients and insurers, order laboratory and radiological tests and dispense medications. The data can be analyzed to judge alternative treatments such as heart bypass surgery versus angioplasty by looking at how quickly patients are discharged and whether they're readmitted. They can also study which medicines work best, spot previously unrecognized disease patterns, identify at-risk patients and even review the performance of individual physicians."

An effective framework for this purpose would seamlessly integrate these fundamental components:

- A **centralized data repository** that synthesizes data from currently incompatible data silos on any platform and format
- **Sophisticated extract, transform and load (ETL) processes** that maintain data quality, so that you can have faith in the accuracy of research based on that data
- **Healthcare-specific analytics** that enable non-statisticians to surface meaningful intelligence from vast amounts of information about patients, populations, providers, procedures and risks
- **Predictive analytics** to deliver more accurate research forecasts, evidence-based treatment protocols and improved patient outcomes

- **Query, reporting and visualization tools** that give various types of users the highest quality of information, where and when needed, via multiple platforms and channels

SAS solutions for healthcare providers

With SAS solutions for healthcare providers, you can get all of these essential ingredients from one vendor — including analytic models and reporting templates.

All SAS solutions for healthcare are built on the SAS Intelligence Platform, a technology framework that extends intelligence to all operating units across the organization and to all types of users, from research scientists to clinicians to administrators and regulators.

The use of consistent metadata (the data that describes how data elements are derived, used and managed) allows data to flow seamlessly across all diverse platforms and applications — as well as other SAS healthcare solutions, which all use the same SAS foundation.

Freeform analysis can uncover unexpected patterns or rules that researchers, clinicians and managers can use to support evidence-based change.

SAS analytic solutions come in all levels of sophistication, from desktop applications for clinical quality teams to sophisticated enterprise wide performance management systems. The solution supports structured and unstructured analysis:

- Structured analysis enables you to evaluate a parameter or hypothesis, such as analyzing reimbursement trends for a diagnostic code or length of stay for a particular condition or procedure.
- Unstructured analysis reveals hidden patterns in masses of data, without having a predetermined idea or hypothesis about what the pattern may be — for example, predicting the response to changes in treatment protocols for ventilator patients.

When you can slice-and-dice, drill down or roll up through various dimensions in a database — applying sophisticated models and algorithms in the process — you can uncover very important patterns and best practices.

For years, healthcare organizations have used SAS analytic solutions to achieve business goals related to cost control, revenue generation and strategic performance management. Now that EMR/EHR systems are becoming more commonplace — and organizations are capturing a wealth of new clinical data — SAS analytics are helping to revolutionize the practice of medicine, not just medical practices.

For example:

- In a medical center, SAS data mining and analytic tools are used to determine whether certain patterns of physician prescribing will optimize outcomes for patients undergoing open heart surgery, taking patient risk factors into account.
- Across a three-facility health system, SAS analytic tools are used to explore clinical outcomes and risk tolerances to improve the overall quality of patient care.

- A community hospital team used SAS to track the long-term care and rehabilitation of spinal surgery patients, to demonstrate to Medicare that although upfront costs were high, cumulative costs were lower than other hospitals and patients returned to productive lives in the community.
- In a health studies institute, SAS analytic tools are used to determine whether certain clinical pathways optimize patient outcomes, in order to achieve best practices.
- Teams in a large healthcare system use SAS for more than 100 projects a year — to assess patient mental states, optimize operating room use by specialty and examine outcomes relative to the use of certain drugs, medical devices and protocols.

The data-based evolution of medicine

For all its Star Trek technological marvels — CAT scans, MRIs, LASIKs and so on — the practice of medicine still operates on a somewhat traditional model. Besides still being highly manual in record-keeping, the practice tends to be reactive: focusing on the treatment of an existing condition.

New data resources are improving the efficiency, cost, accuracy and outcomes of medical treatments, but the future holds even greater potential. Predictive analysis of diverse data promises to revolutionize the essential model of healthcare delivery. With predictive insights based on vast amounts of clinical and research data, the focus can shift more toward proactive and preventive care.

Sophisticated data analysis is already fueling three exciting trends in medicine:

- **Evidence-based medicine** focuses on the conscientious, explicit and judicious use of current best evidence in making decisions about patient care — integrating clinical expertise with the best available research results.
- **Protocol-based medicine** brings the results of research to the bedside in the form of best practices that are continuously updated based on analytic assessment of patient populations.
- **Personalized medicine** acknowledges the uniqueness of individuals and provides the right treatment in the right format to the right individual at the right time. This approach blends genotypic data, medical images, environmental data, genetic profiles, molecular and genetic research efforts and targeted pharmaceuticals with historical clinical data to lead to personalized diagnosis and treatment.

Evidence-based medicine focuses on how medicine is practiced. Protocol-driven medicine describes a methodology for advancing research through clinical practice. Personalized medicine describes an ideal (but achievable) future state of customized care. With EMR/EHR, coupled with predictive analytics, the healthcare industry is advancing forward into all three ideals.

About SAS

SAS is the world's largest privately held software company, with 3.5 million users at more than 39,000 sites in 110 countries. SAS is also a leading provider of clinical and business intelligence. Healthcare executives at more than 500 hospitals worldwide use SAS software to enhance quality of care, contain costs and drive service growth. SAS solutions span all areas of clinical care management, clinical research analysis, strategic and marketing planning, organizational management and performance management.

For more than 25 years, SAS has been giving healthcare organizations *The Power to Know®*.

For more information, visit us on the Web at **www.sas.com**.

SAS leverages the investments you have already made (or are about to make) in EMR/EHR systems and applications by adding a unique layer of intelligence you can't get anywhere else.

References

[1] Marietti, Charlene. "Mountains to Climb: Cost isn't the biggest obstacle on the way to EMRs," *Healthcare Informatics* (October 2004)

[2] Whiting, Rick. "Analytics Move to the Clinic," *Information Week,* Healthcare Enterprise special edition (Spring 2004)

World Headquarters
and SAS Americas
SAS Campus Drive
Cary, NC 27513 USA
Tel: (1) 919 677 8000
Fax: (1) 919 677 4444
U.S. & Canada sales:
(1) 800 727 0025

SAS International
PO Box 10 53 40
Neuenheimer Landsr. 28-30
D-69043 Heidelberg, Germany
Tel: (49) 6221 4160
Fax: (49) 6221 474850

www.sas.com

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