Transforming Healthcare through Better Use of Data*

Jared Rhoads and Lynette Ferrara

Abstract

Hospitals and health systems have more pressures and more incentives to become data-driven. Competitive pressures, changes in rules and reimbursement and opportunities to gain incentives are all making it necessary for organizations to improve their clinical quality and efficiency. Many organizations already have large data resources but they need to develop the foundational practices and capabilities to get the most out of these assets. In this paper, we indicate three areas that can be improved through the better use of data and describe six key building blocks that need to be addressed in order to approach this opportunity.

Key Points

- In order to improve care, reduce costs, and optimize performance, hospitals and health systems need to become more data-driven.
- Many organizations already have the data they need, but lack the foundational practices and capabilities to get the most out of these assets.
- The current generation of data warehousing technology will remain important, but the next wave of data will be bigger, less structured and less easily integrated.
- Before engaging in the new data-driven paradigm (e.g., Big Data), organizations need to assess their plans and approaches to the following six areas:
  - Data Governance
  - Data Acquisition
  - Data Sharing
  - Data Standardization
  - Data Integration
  - Analytics

New Drivers to Become Data-Driven

Hospitals and health systems have more reasons — and more incentives — than ever to become data-driven. Increasingly they are being expected to take on more responsibility for improving the quality and safety of care for patients, improving care outcomes, and tackling healthcare cost inflation. Overall there is greater pressure on health delivery organizations to improve their clinical quality and efficiency. They are even expected to achieve better health, nutrition and physical activity for populations by engaging patients "upstream" and beyond traditional settings.

Change is also being spurred by developments on the ground level, such as the meaningful use incentive program for electronic health records (EHR), value-based purchasing accountable care and other CMS rules affecting reimbursement. The shift toward the meaningful use of EHRs, for example, will help to create what the Office of the National Coordinator (ONC) envisions

* Originally published by CSC at: http://www.csc.com/health_services/insights/80497-transforming_healthcare_through_better_use_of_data, reprinted with permission.

will be a *learning health system*. In this scenario, "the right information will be available to support a given decision," whether it has to do with treatment, medication, or the research and development for a potential new treatment.[1]

The key to responding to such a vast array of changes is for health delivery organizations to become more skilled at leveraging their data. Organizations can use their data to improve patient care, drive innovation and improve organizational performance.

Most organizations have more data to work with than they realize but they need to recognize the challenges and plan to overcome them. For example, the data landscape is constantly changing. The size, scope and types of data available are rapidly evolving and so are the tools needed to make sense of it all. To identify competitive advantages and achieve better command and control over their data, entrepreneurial healthcare executives need to recognize this evolution and understand the building blocks that we present in this paper.

Enhancing Performance by Leveraging Data

There is an immense amount of data already available to health delivery organizations as a byproduct of the practice of medicine. Three major areas of opportunity for enhancing performance with data are improving patient care, reducing costs and managing performance.

Improving Patient Care

Hospitals and health systems need to leverage their data to find ways to improve the way they deliver care. To date, many providers have undertaken a relatively limited use of their data. Often their efforts at tracking and improving care are limited to relatively basic reporting, scorecards and dashboards.[2] These efforts tend to be localized and constrained within departments, rather than across departments and organizations, where greater value can be attained. Improving care is especially critical under a system of value-based purchasing, in which a hospital's reimbursement is linked to its performance on core quality measures.

> Technology experts at the Cleveland Clinic predict that extracting value from datasets will be one of the top 10 innovative medical trends for 2012.
>
> They believe that data analysis can improve hospital operations and clinical outcomes. They also believe that it can create valuable benchmarks for studying cost effectiveness, enabling them to identify the best treatment options based on patient characteristics.[3]

Making use of data is critical for the next generation of decision support and quality management. Hospitals need to use the data they have to design an effective care plan that will deliver a high-quality outcome, preferably at a lower cost. Analytics tools revealing patterns correlating treatments and outcomes can be incorporated into support tools to help diffuse new medical knowledge.[4] Organizations can mine their data to identify more effective ways to engage in population health management and disease management. Meanwhile, rule-based tools and predictive analytics can be used to make fact-based decisions on how to improve quality.

> Analyzing large data sets could generate $300 billion (US) in value over the long run, with approximately two-thirds of that coming from a direct reduction in national healthcare expenditures.[6]

Analytics tools can also reveal clues on how to improve care, thus decreasing the frequency of misdiagnoses and dangerous drug interactions. This improves outcomes, saves time and minimizes patient distress.[5] Advanced tools like visual analytics allow analysts to look more deeply for patterns and identify which care processes are most effective and how they can be fine-tuned.

Data-intensive care will eventually inform treatment protocols, allowing organizations to become increasingly evidence-based. The meaningful use EHR incentive program is already creating incentives for paper-based systems to become more digitized — the next milestone will be reached when systems become more integrated. Soon the infrastructure will be in place to enable clinicians to improve patient care by considering data that have not traditionally been available, ranging from information on drugs and genomes to logs of patient behavior and biometrics.

Reducing Costs

With new reimbursement models on the horizon, such as bundled payments and the accountable care model, healthcare providers are facing new incentives to reduce costs. Financial penalties for 30-day readmissions will reduce Medicare payments by as much as 3%. These penalties provide a strong incentive for organizations to use data to figure out how to avoid costly duplication of effort and unnecessary retesting.

Another way to use data to reduce costs is to examine billing records and medical records for errors and inaccuracies. One company has developed a tool that analyzes large streams claims data and finds errors and anomalies that can translate to large savings for hospitals and health plans.[7] The tool analyzes an organization's data specifically to identify the types of small unintentional errors that tend to go unnoticed and are generally invisible to conventional audits but that accumulate over time.

Managing Performance

Improving overall financial performance is a perennial concern

that has been brought to the forefront by current economic conditions and by changes in the industry. One thing that makes performance management more challenging is the fact that data are dispersed across different organizations: payers have the detailed financial data while various providers (and patients themselves) have the clinical data.

These data need to be brought together to create an intelligent, learning health system. Already some health systems are beginning to leverage consumer health and financial data to develop customer segmentation strategies that drive profitable business. Hospitals can promote much-needed services, such as cancer screenings and cholesterol tests for patients who are identified as high-risk.

Flexible reporting tools can be used to identify which treatments are the most profitable and which providers are the best at performing them.[9] Organizations can take performance management to the next level by applying these strategies to increasingly granular levels of care processes, and doing so with real-time responsiveness. Ultimately these are examples of doing well by doing what is good for the patient.

Getting Value from Your Data: The Building Blocks

There are new ways to use data in productive ways. For example, new health intelligence applications have been adopted by many hospitals to analyze data from disparate sources spanning the clinical, operational and financial domains.[10] Executives and managers can use these applications to create online performance dashboards and run reports on demand.

Not every provider organization and independent practitioner has the resources, scale or expertise to launch their own data warehousing and analytics program. But large and medium-sized institutions should be able to assemble a compelling business case. The winners in the coming age will be the organizations that use larger, faster and more disparate data sets to generate a competitive advantage.

Many data-driven initiatives will have to be experimental since the opportunities are unknown until revealed through the use of analytic tools.[11] Before moving forward, organizations should be aware of six key building blocks: data governance, data acquisition, data sharing, integration, standardization and analytics.

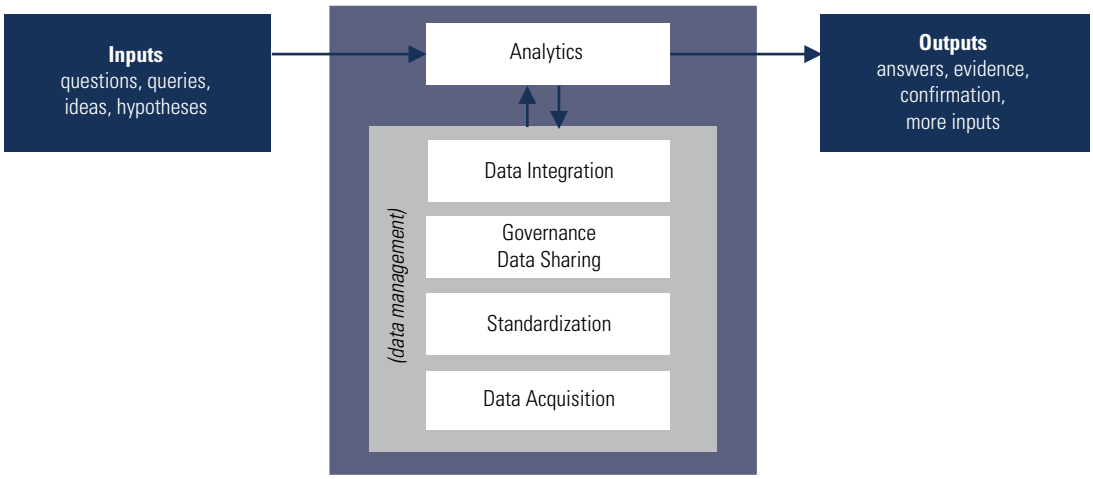
In 2011, the Henry Ford Health System dug into its patient database and promoted mammograms in mailings to 30,000 women aged 40 or older. More than 5,700 women responded, which was 304 more than in the control group. The mailings generated $268,000 in additional profit.[8]

Data Governance

Before any organization embarks on a new large-scale data initiative it should develop a clear data governance plan. This plan describes how the organization will collect, maintain, protect and curate data assets. According to one definition, data governance is "a system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods."[12] Governance includes guidelines for sharing data, such as how it may be done, when and with whom.

Many organizations fail to address governance early on, but

FIGURE 1.
Conceptual view of getting value from data



a good governance plan is important because it sets the expectations for the policies, standards and business rules for using data. Governance helps business leaders determine the types of questions they can ask of the data and how. When new insights are revealed, a governance plan can help leadership address the opportunity without causing unwanted disruption to existing business practices. It also provides controls to limit or prevent undesired uses of the data.

CSC developed a system to connect general practitioners in the United Kingdom to patients at home for after-hours visits. The automated system captures location data from mobile devices and improves performance by assisting with dispatch, navigation, tracking and reporting of mobile doctors to help deliver faster care to more patients.

A best practice in this area is to set up special competency centers, or Centers of Excellence (COE), within the organization. A central COE can be tasked with integrating analytics across the enterprise, and it can participate in decision-making for key data-related matters.

Data Acquisition

Traditional data warehouses tend to contain highly structured data that are acquired from traditional in-house systems. These data certainly have great value, but new opportunities are also emerging from the acquisition of unstructured or semi-structured data. These come from disparate sources (e.g., patients, home monitoring systems, other caregivers) and are apt to arrive in the form of free text, audio, video or streams of sensor data.[13]

Good data acquisition means ensuring that data are captured in a usable form. Best practices include consistent documentation of metadata and classification of data elements. Standard taxonomies for demographic fields and medical codes should be used. New tools like shared nothing architectures, MapReduce and Hadoop can help with the technological challenges of capturing and processing unstructured data. Finally, for privacy and security, patient records should always be properly deidentified.

Data Sharing

Organizations looking at terabyte- and petabyte-sized data warehouses may think they already have more data than they need, but they may only have one piece of the puzzle. To maximize the value of the data, organizations need to collaborate and cultivate relationships that encourage sharing data across the provider, plan and life sciences communities.

One new trend in data sharing is to "virtualize" selected data from disparate sources or multiple facilities. Data virtualization is a technique that allows multiple applications and multiple users to access and work with the data at the same time. This makes it easier for people across the organization to perform analysis and reporting. Cloud computing is a related idea that makes it possible for organizations to migrate large amounts of data onto a temporary platform. Users can log into the cloud and run high-powered analytic tools or reports, and then release the IT resources when they are finished. This can be attractive from a cost management perspective because organizations only pay cloud service providers for the computing resources that they use, thus avoiding large capital expenditures for servers.

Data Standardization

Despite the numerous standards that have been promulgated, there is still relatively little interoperability in the healthcare industry. Organizations need to be aware of the need to carefully select and adhere to common data models so that data from disparate systems can be combined and compared. This is an important benefit of good data governance.

Delivery organizations can learn from research efforts that have pioneered new solutions for standardizing data. At the National Institutes for Health (NIH), for example, the Biomedical Translational Research Information System (BTRIS) translates data from different sources into a standard structure and language so that it can be managed and analyzed more easily.[14] This allows researchers to query multiple data sources at once and get more comprehensive results. New NIH research partners, including academic medical centers, are being added over time to increase the amount of available data.

Healthcare data can generate value on a large-scale when common data models are used. During the 2009 flu pandemic, CSC designed a system for the U.S. Food and Drug Administration to help ensure population health by monitoring vaccine safety. The Post-Licensure Rapid Immunization Safety Monitoring (PRISM) system monitored over 35 million people across five national payer databases, linked with immunization registry data from nine states. Data were put into a common model so that participating organizations could run analyses and share results, averting potential health disasters.

Data Integration

Data integration is the merger of data from internal and external data sources into a single patient-centric data structure optimized for analysis. Examples include the merger of patient demographics, conditions, procedures, drugs and observations from an electronic medical record, along with lab values and diagnostic results from other clinical systems. Data from physician electronic medical records may be combined with

Case Example: Real-Time Clinical Surveillance at the University of Kansas Hospital

The coming phase in health delivery will require real-time clinical surveillance and reporting in order to provide continuous monitoring of clinical information as clinicians provide care. The University of Kansas Hospital (KUHA) and CSC have partnered to develop that capability.

Through a new tool called CareVeillance, clinicians receive alerts when patients show early signs of high-risk conditions like pneumonia. The system integrates patient data from disparate systems, analyzes these data against sets of rules, and then presents actionable information to clinicians. At KUHA, CareVeillance has helped clinicians identify patients with sepsis early in their hospitalization, allowing them to intervene immediately. In some cases, patients with sepsis were identified even when they were not detected through other approaches.

The system monitors for adverse events and can also provide alerts for best practice interventions. Unlike with existing business intelligence systems or data warehouses, the system processes new data on the patient, not old data that may no longer be useful for making decisions about immediate clinical interventions. KUHA, an early adopter of the technology, is using the system to help reduce complications, hospital-acquired conditions and readmission rates. They will also use it to improve the way that they manage their performance and reporting on core measures, and to submit clinical quality measures for the meaningful use EHR incentive program.

data from inpatient data. For operational or financial analysis, administrative claims data is added to the data structure.

Analytics

Analytics is the final component that delivers the payoff. Once all of the other building blocks are aligned — from governance to standardization — organizations can apply analytics tools to glean meaningful and actionable insight from their data.

Organizations using analytics can discover entirely new things about their enterprises. Analytics can help monitor, predict and optimize the financial and operational performance of a hospital by allowing areas like staffing, admissions and reimbursements to be analyzed in depth. Likewise, analytics can improve clinical performance by assisting with clinical decision support, comparative effectiveness research, patient safety and compliance with care protocols. Predictive analytics is even being used in information security, to anticipate data breaches and data losses before they occur.[15]

New analytics tools go beyond what standard reporting and business intelligence can offer. They include 3D graphing and visualization, interactive interfaces, animation, displays of multiple variables and more. Visual representations help highlight important features of the data, including commonalities and anomalies. These connections would otherwise be too difficult to see if the only available outputs were tables full of numbers.

What's Next: The Health Data rEvolution

The current generation of health information systems is based largely upon data collected during medical encounters: visits, procedures, and medication, lab and diagnostic tests results. In his keynote to the 2011 America Medical Informatics Association, Dr. Gregory Abowd warned that data generated outside the clinical setting will soon be as — if not more — important to care delivery.

For instance, mobile health systems record detailed biometric data along with logs of the patient behaviors and attitudes. New machines now provide gene sequencing for under $1,000. The result will be a rich and varied source of information on each patient (see Figure 2) that may be used to help patients avoid or manage chronic disease, deliver truly personalized health care and/or proactively monitor safety and quality of care.

Advanced analytics is a rare capability held by only a few healthcare organizations today. Those who do tend to have highly-skilled analysts who form small but collaborative groups. Support from senior leadership is crucial.[16]

This next wave of data will be bigger, less structured and less easily integrated. The current generation of data warehousing technology will remain important for standard reporting. A new generation of technology already widely used in clinical research will become embedded in care delivery. This will include:

- "Shared nothing" infrastructure and data base architectures that distribute and divide the once time-consuming tasks required to acquire, manage and analyze data.
- Next generation databases (Hadoop and MapReduce) and new, unstructured query technologies (non SQL) that enable rapid discovery of patterns in massive, unstructured data. Search-based applications technologies will reduce the time and effort to explore and organize massive and diverse text data ranging from research journals to patients reported outcomes.
- Analytic tools that are easy to learn and use will enable clinicians and patients to explore patterns in data. Visual analytics will enable clinicians to review their patient population, exploring the effects of choice of medication and procedures, patient demographics, and patient behavior and attitudes.

These same tools will enable patients and their families to better understand how their behavior and possibly the neighborhoods where they live and work influence their health. Predictive Analytics provide real-time advice for clinician and patients based on their own data and from learning gleaned from similar patients.

Data warehouses, standard reporting tools and current analytics applications will continue to provide value for some time to come, but the next wave of data will be a highly disruptive force. Over the next five years, organizations will gain or lose ground based on who can make the best use of their data.[17] The ability to cope with large amounts of data — which starts with the basic building blocks outlined in this paper — will soon be a competitive necessity. EH

Case Example: Improved Data Management and Governance at UW Health

UW Health, the academic medical center and health system for the University of Wisconsin, recently completed a large implementation of a new electronic health record system. Despite a successful implementation, they found that it was difficult to harvest meaningful information out of the reporting database due to some inherent complexities and quality issues with the data. Users spent more time extracting, transforming and loading data than analyzing it and taking action based on their findings.

With the help of CSC, they established a new Health Information Management Center (HIMC), staffed with experts in data warehousing, business intelligence, and subject matter experts from across UW Health. Key priorities of the new HIMC include executing on plans for data governance, data quality and data standards. The new data governance strategy establishes more accountability for information quality by putting data owners in charge of approving business measure definitions, formulas and business rules. To improve data acquisition, automated tools have been put into place and handle tasks like loading and error-checking with minimal human intervention.

Another key part of the solution is the data mall, which consists of a series of interconnected data marts. This enables faster access to more consistent information across the enterprise. Overall, the combination of the HIMC and supporting technologies will help support UW Health's strategic initiative of becoming a data-driven organization.

FIGURE 2.
An explosion of health data

Organizations are facing an explosion of patient health data. Characteristics of the "Health Data rEvolution" include:

- Introduction of new kinds of data that are both people-generated and machine-generated (e.g., patient reports, health monitors and genomic data)
- Massive in size (petabytes, not terabytes)
- Complex and diverse
- From disparate sources
- Organized and managed for rapid processing
- New tools for gleaning insights from the data
- New linkages between data (time and place)
- Opened up for more widespread analysis, use and experimentation

Acknowledgments

The authors would like to thank Jordan Battani and Erica Drazen from the Global Institute of Emerging Healthcare practices, the research arm of CSC's Healthcare Group, Robert Reese, Managing Director of CSC's Healthcare Providers practice, and Dan Foltz, Director of CSC's Health Informatics Practice, for their assistance with this white paper.

About the Authors

Jared Rhoads is a senior research analyst with CSC's Global Institute for Emerging Healthcare Practices.

Lynette Ferrara is a partner in CSC's Global Health Care Sector.

References

[1] "The Federal Health IT Strategic Plan (2011-2015)" Office of the National Coordinator, November 4, 2011

[2] "HLSARC Research Brief #2" International Institute for Analytics, December 15, 2010

[3] "Experts Predict Ten Emerging Technologies that will Shape Health Care Next Year" Cleveland Clinic, October 6, 2011

[4] "Big data will transform healthcare, says ONC" *Fierce Government IT*, March 27, 2011

[5] Olds, D. "Big Data and Doctors: Analytics-led Medicine is Coming" inside-bigdata.com, October 3, 2011

[6] Shaw, G. "Healthcare's Missing a Big (Data) Opportunity" *HealthLeaders Media*, October 11, 2011

[7] "HPA Harnesses the Power of 'Big Data' to Generate Big Savings in Healthcare Spending" *Fierce Healthcare*, November 1, 2011

[8] "Hospitals Mine Their Patients' Records in Search of Customers" *Kaiser Health News*, February 5, 2012

[9] "HLSARC Research Brief #1" International Institute for Analytics, September 15, 2010

[10] Foltz, D. and F. Turisco, "Health Intelligence: For Performance-Driven Hospitals" CSC, 2008

[11] "HLSARC Research Brief #2" International Institute for Analytics, December 15, 2010

[12] "Definitions of Data Governance" DataGovernance.com, February 14, 2011

[13] Stupakevich, B. "Top Considerations When Working with Big Data" SmartDataCollective, August 13, 2011

[14] "Research Accelerates at NIH with One-Stop-Shopping for Data" CSC Case Studies, 2011

[15] "HLSARC Research Brief #6" International Institute for Analytics, March 3, 2010

[16] "HLSARC Research Brief #2" International Institute for Analytics, December 15, 2010

[17] Prentice, S. "CEO Advisory: 'Big Data' Equals Big Opportunity" Gartner, March 31, 2011