Working smarter in healthcare

How four organizations are optimizing patient care and performance
Great healthcare organizations across the world have a unifying mission: improving the quality of care to patients. This holds true for organizations with responsibility for direct patient care such as healthcare networks and clinical medical centers as well as companies whose products and services support patient care, including healthcare insurers, pharmaceutical companies and medical device manufactures. Healthcare companies that are great innovators, business partners and industry leaders manage operations, productivity, services and costs within the context of continuous improvement.

Globally, the healthcare industry is confronted with many challenges, ranging from great disparities in the levels of care available to individuals to issues related to privacy legislation and the need to provide more holistic patient care for less money. Technology is providing the catalyst for some of the most innovative solutions to these healthcare challenges and is helping to revolutionize the delivery of healthcare across the globe.

Over the past 25 years, many healthcare organizations have effectively used information technology to automate business processes within the individual units of the organizations. Today many of these same organizations are making healthcare smarter by using technology in new ways to bridge the silos of a complex medical ecosystem and deliver more intelligent and higher quality care to patients. Technology is used to create collaborative environments across these ecosystems and to enable more advanced levels of analysis about patient health and better decisions about the management of diseases.

Many of the advances in medical technology—such as improved detection of internal abnormalities through use of digital imaging, and sensors that automate monitoring of heart abnormalities in cardiac patients—generate an enormous amount of data. This increase in instrumented and intelligent medical devices and systems means that many healthcare institutions are processing more information than ever before. Gaining the greatest benefit
from these technological advances requires making sure that this information is being accurately and adequately used. When healthcare companies find smarter ways for clinicians, researchers and administrators to access and analyze information, they can improve quality, reduce risk, and increase the certainty of making the right decision at the right time.

In this paper, we look at four of IBM's healthcare industry clients—The Mayo Clinic, The University of North Carolina Health Care System, Cubist Pharmaceuticals and Hanover Medical School (Germany)—that are using information and technology to transform the quality of healthcare. They are focused on improving treatment outcomes for patients while optimizing business processes and creating collaborative work environments. All of these companies are on a journey characterized by continuous improvement in the way IT is orchestrated to serve the needs of the business.

**Building the foundation**

While there are many different approaches to smarter healthcare, organizations typically focus on three foundational areas as they strive to create a more agile, collaborative and connected healthcare system and deliver results that improve people's lives:

- **Health informatics**—applying information management, technology, analytics and medical science to solve healthcare challenges
- **Collaboration**—redefining how people in healthcare communities work together across departmental and organizational boundaries
- **Service-oriented architecture**—bringing people, processes, information and technology together for a more agile business

Depending on their priorities, organizations can take a smarter approach to healthcare by beginning with any one of the three foundational areas; however there are some important connections and synergies between them. For example, a flexible underlying infrastructure based on service-oriented architecture will add to the value derived from an analytics engine.
Health informatics

Many leading healthcare organizations have established informatics teams or centers of excellence dedicated to supporting medical researchers, clinicians and administrators in their quest to combine data in new ways and helping them understand complex, interrelated issues far more easily. These organizations are finding great benefit in using advanced computing power and analytics software to collect and analyze the large volumes of data streaming in from sensors, patient monitoring systems, medical instruments and handheld devices. Such data can be used to bring a new level of intelligence to health care to help doctors, nurses and medical staffs tackle complex problems such as disease management, hospital quality improvement, patient population studies and performance reporting.

Given the need to combine advanced technologies with medical expertise and clinical guidelines, many prominent medical centers have partnered with IBM to advance health analytics technology. Best practices developed over many years of IBM engagements with its healthcare clients have been codified into Healthcare Industry Frameworks that can be used to deliver results faster. In addition, based on the deep knowledge gained through its work innovative healthcare organizations, IBM established a Health Analytics Solution Center to help more organizations benefit from this approach.

Collaboration

It’s no secret that advancements in medicine have led to increasing levels of specialization among physicians and researchers. As a result, the process of getting the diagnosis right, determining a treatment plan, executing the treatment and ensuring appropriate follow-up may for a complicated illness requires a very large team of medical and surgical specialists, nurses, social workers and administrators. As healthcare organizations have grown in complexity—many large medical centers have created partnerships with or acquired smaller hospitals—the participants in this healthcare ecosystem can’t always get the information they need to make timely and smart decisions. The IT systems in these widening ecosystems were not created to work together, and just making sure that everyone has access to quality information and expert advice when they need it can be very challenging.
It’s not just the large medical health centers that are experiencing these communication and collaboration challenges. Pharmaceutical companies and healthcare insurers also find that barriers to effective and efficient collaboration are inhibiting their employees and business partners from achieving their goals. But there is a better way. Social networking technologies and collaboration tools are helping people to redefine the way they interact and share information with each other. Companies are working with IBM to help build a culture of innovation in their organizations based on the ability to share knowledge across pre-existing boundaries.

Service-oriented architecture

Many healthcare organizations face a common problem: organizational silos, with their disconnected silos of information and applications, make it hard for people to access the right information or the right expert advice at the right time. To achieve the goal of improving the quality of patient care, critical information has to cross these internal and external boundaries so that physicians, researchers and administrators can communicate and share information.

Healthcare needs a smarter way to design IT to bring people, processes and information together in an agile business environment. Service-oriented architecture (SOA) allows many healthcare organizations to more easily link business services and data across departments and integrate the requirements of the business with a technology framework that enables flexibility and change.

Case Study 1: The Mayo Clinic — leveraging algorithms to improve diagnostic accuracy

The Mayo Clinic is a world-class medical institution dedicated to delivering the best care to its patients through integrated clinical practice, education and research. The organization is committed to continuously improving all processes that support the Mayo Clinic in its efforts to provide high quality care and meet the needs of its patients. Many of its patients come from all over the world and, therefore, need to compress a lot of activity—including multiple tests and specialist consultations—into a very short time. Understanding the need for patients to get a lot done during each visit—without delays caused by incomplete tests—has contributed to the hospital’s culture of speed and efficiency in all of its work.
SOA in practice:
IBM uses an integrated approach

Highlights

Improving the quality, speed and reliability of imaging technology was an early goal of the Mayo clinic.

Improving speed of analysis

Medical imaging technologies such as computed tomography (CT) scanning and magnetic resonance imaging (MRI) have revolutionized medicine by providing ultra-detailed—and noninvasive—tools to detect and diagnose internal abnormalities. This is generally done by comparing scans over two or more time periods to detect changes in either the size or location of an abnormal mass or condition. In order to optimize results from these advanced imaging technologies, radiologists need to be highly skilled at viewing vast amounts of detail contained within a multitude of digital images. For example, in the case of CT scans, which produce a series of cross-sectional images, radiologists need to analyze each image, a time-consuming and exacting exercise.

Radiologists need to be able to identify subtle changes in the images taken over time in order to detect tumors or other problems at an early stage. The medical images need to not only be crisp but also as close to “apples-to-apples” comparisons as possible. Getting them to this point generally requires special algorithms—some to correct image blur or distortion commonly caused by the patient’s breathing, heartbeat or movement, others to properly align images when the patient’s position or equipment differences caused a difference in image orientation. Given the complexity of these algorithms, it can take hours to run them and determine if the original images were correctable.

Leveraging algorithms to improve diagnostic accuracy

Providing accurate and fast analysis of medical imaging tests is critical to delivering excellent patient care. The Mayo Clinic’s Medical Imaging Informatics Innovation Center (MI3C) was created to help transform the way the hospital processes and interprets medical imaging results. The MI3C combines advanced computing and image processing capabilities with optimized algorithms to provide faster and more accurate image analysis. One of the early goals of the MI3C was to reduce the chance that patients would need to be called back to repeat an imaging test that was incomplete or unable to be properly read because of distortions that couldn’t be electronically corrected.

Mayo Clinic and IBM worked together to fine-tune image correction algorithms, enabling Mayo radiologists to interpret results 50 times faster.
Pooling their complementary expertise, Mayo Clinic and IBM modified the image correction algorithms to take full advantage of today’s powerful computing architectures. Now the MI3C can execute the algorithms 50 times faster, enabling radiologists to interpret results within minutes of the test.

Improving diagnostic accuracy
In addition to shortening the image processing cycle, Mayo Clinic saw the opportunity to use the MI3C expertise to improve the radiologist’s diagnostic accuracy—and therefore the quality of patient care. Using IBM WebSphere® Process Server to model and orchestrate diagnostic processes, IBM worked with Mayo Clinic radiologists to design a medical imaging workflow that enables radiologists to run detection algorithms in the course of their typical activities, using their existing technology.

There are many imaging tests with challenging radiology detection requirements. For its first test of the new imaging workflow process, the Mayo Clinic selected Magnetic Resonance Angiography (MRA), which produces pictures of blood vessels in the brain. Radiologists need to follow an especially complex and manual process to properly analyze MRAs to identify possible aneurysms, the abnormal bulging outward of arteries in the brain. After MRAs are taken, the images are automatically transferred to MI3C servers, where algorithms align the images properly and analyze them (based on Mayo Clinic criteria) to find and visually mark potential aneurysms. The results can then be routed to Mayo Clinic’s PACS (Picture Archiving System) network, where they are viewable on the radiologist’s workstation.

This solution generated a 95 percent accuracy rate in detecting aneurysms, compared with 70 percent for manual interpretation. With such impressive results, the Mayo Clinic plans to apply the same approach for other tests, such characterizing breast lesions with MRI. Because the underlying technical infrastructure is based on a service-oriented architecture, the imaging workflow solution can be efficiently re-used and extended to other radiological processes.
The University of North Carolina (UNC) Health Care System: using information to improve patient care and drive research

The University of North Carolina Health Care System needed to create a consolidated view of patient information that could better serve the diverse needs of varied user groups. The organization was facing a considerable information management challenge in the form of a vast array of data repositories and demands. There are discrete clinical and administrative systems for physician noting, radiology, oncology, cardiology, lab results and admissions, among others. The basic issue was that little or no cross-referencing or synchronization of these systems existed. Asking the same question of different systems could often yield different, yet equally valid, results. Further, some questions—those for which the answers require data to be retrieved from more than one source—could not be answered effectively because there was no way to look across multiple data silos.

UNC knew it needed to consolidate and aggregate the data, and began that process by creating two large data stores, one for clinical data and one for operational data. However, it was clear that this effort would only deliver some of the desired benefits. To achieve its goals, UNC would have to add both structure and capability to the picture.

IBM Global Business Services worked with the UNC team to create the robust governance structure that was the key prerequisite for development of a powerful data warehouse. With the governance structure in place, UNC looked to IBM to develop and deploy the data warehouse leveraging its Health Integration Framework. The centerpiece of the implementation is IBM InfoSphere™ Information Server, a scalable, integrated platform for decision support. The new data warehouse unifies multiple data stores, making it possible to quickly and easily access data and transform it into useful information. This gives UNC the ability to quickly and easily leverage health informatics to analyze data in new ways, improving patient outcomes, disease management, regulatory compliance and research.

Solution components:
UNC Health Care System

Software
- IBM DB2®
- IBM InfoSphere™ DataStage®
- IBM InfoSphere Information Server
- IBM WebSphere® Application Server
- IBM WebSphere Portal
- IBM WebSphere Portlet Factory

Services
- IBM Global Business Services

The lack of a unified data store hampered UNC’s ability to cross-reference patient information or improve existing processes.

IBM technology collects data from many sources and leverages UNC’s existing analysis tools to provide highly detailed, Web-accessible information across the UNC organization.
Integrating seamlessly with UNC’s existing analysis tools, the InfoSphere platform enables sophisticated data analytics to be delivered in real time—a new capability that enables true health informatics for the entire UNC Health Care System. Web-enabled access is provided via IBM WebSphere® Portal and WebSphere Application Server, with functionality built using IBM WebSphere Portlet Factory.

Practical benefits, powerful scientific impact

Today, healthcare funding and compliance have become major issues. The requirements for performance benchmarking (i.e., establishing that diseases are in fact being managed effectively) are becoming increasingly stringent, and are coming from both the government and health insurance companies. The data warehouse is essential to meeting these requirements. It allows, for example, records for the entire patient population to be quickly examined for pertinent measures, such as blood pressure. Previously, this information was either difficult or impossible to derive due to multiple “versions of the truth” caused by lack of synchronization.

The impact of the new data warehouse on research initiatives has been revolutionary. In one compelling example, a researcher needed a specific set of “blinded” (anonymous) patient data in order to conduct a study of kidney disease. Prior to the existence of the data warehouse, this task would have required reviewing hundreds of medical histories manually. With the new data warehouse, a simple query delivered results in just minutes.
Cubist Pharmaceuticals: streamlining clinical trial management and improving collaboration

Based in Massachusetts, Cubist Pharmaceuticals, Inc. is a biopharmaceutical company dedicated to developing new anti-infective medications for the acute care environment. The company’s research has involved finding new solutions to combat the health challenges caused by “super-bugs” which are rapidly rendering traditional antibiotics obsolete. New drugs must pass through a comprehensive series of clinical trials before they can be brought to market. Phase 3 clinical trials in particular are very complex and very challenging to manage, typically involving between two and three thousand patients distributed over 100 hospitals and spanning up to two years.

Although Cubist had a home-grown clinical trial management system, it was inefficient and unable to keep pace with the company’s rapid growth. Once the company began running multiple phase 3 trials simultaneously, the system simply could not scale to meet the required record-keeping and process management tasks. The existing system made it difficult to share information across internal teams and among the various clinical sites. The limited reporting capabilities of the internal database system forced employees to use spreadsheets and other manual tools to analyze trial status data and share critical information with others.

Without a consistent way to share information, the company was limited in its ability to report metrics, spot trends and take proactive steps to correct problems. And without the capability to automate workflows, most of the business processes were handled manually. For example, there was no way for the system to alert the team when it was time to execute a critical action—such as making a payment based on achievement of a milestone—resulting in delays and the need for human intervention at nearly every step of the clinical trial.

IBM Business Partner Winchester Business Systems created a solution that manages the global trials of drugs, devices, biologics and vaccines in all phases of development.
Improving collaboration and business process efficiency

Cubist Pharmaceuticals needed a way to eliminate barriers to effective communication and efficient, end-to-end management of the clinical trials process. The company implemented Protocol Manager, a software solution designed by IBM Business Partner Winchester Business Systems to manage the clinical operations of global trials of drugs, devices, biologics and vaccines in all phases of development. Cubist uses the solution to manage budget information, actual spending, trial status and milestones, site monitoring activities and reports, study supplies and more.

Protocol Manager is based on IBM Lotus® Notes® and Domino® software, which makes it easy for Cubist to customize the system to adhere to its unique terminology, standard operating procedures and reporting requirements. What’s more, the Lotus Notes and Domino platform has a powerful workflow engine that allowed Cubist to automate critical processes, dramatically improving efficiency while creating an audit trail where needed.

To facilitate process management, Cubist also integrated Protocol Manager with the company’s e-mail system. Now, when an employee completes a task and submits it into the system, the next person in the process is automatically notified. In the future, the team plans to allow partners and clinical site personnel direct access to select areas of the system via a Web portal so that external users at clinical sites can access information securely over the Internet.
Leading University medical center: using SOA and RFID technology to keep track of patients and assets

This leading European university medical center delivers world-class research and patient care. It wanted to enhance patient safety, improve the quality of the treatment services, and reduce patient waiting time, optimize its processes and better support its special operating conditions. However, the center lacked an IT solution to facilitate tracking the patient from enrollment through discharge which would ultimately optimize the treatment process by prioritizing treatment based on each individual’s medical need.

Typically, patients were entered into the hospital information system (HIS) as soon as they arrived at the facility—but after that, the IT support ended. There was no system in place that could track admissions by medical priority or track patients as they moved through the hospital system. The lack of a comprehensive tracking system could potentially put patients at risk since it was difficult to identify which patients needed the most urgent medical care.

The medical center engaged IBM to create a comprehensive patient tracking solution that would integrate with the existing HIS. By deploying new technologies, it hoped to create a solution that automatically gathered and recorded data about patient treatment, including details regarding waiting times and...
patient location. The company wanted the solution to utilize its existing wireless local area network (WLAN). In addition, the center wanted a scalable solution that could include other enterprise-wide capabilities, such as helping it locate and track medical devices, reducing the need for investment in new assets and optimizing the maintenance process by locating devices faster.

A team from IBM Global Business Services and IBM Global Technology Services designed and implemented a solution that uses radio frequency identification (RFID) technology to automatically track and record the position of each patient and a WLAN-based infrastructure to capture and transmit the RFID data. A complex-event processing engine automatically aggregates location changes and other events into process-relevant information, resulting in data such as “patient waiting for doctor at room x.” A business-to-employee portal provides the dashboard functionality necessary to present relevant events and data to medical staff and gives the medical center a platform for a future enterprise portal.
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Highlights

Service-oriented architecture enables greater collaboration between healthcare organizations and their partners, providing a scalable infrastructure that can help achieve patient care goals.

Summary

The healthcare organization case studies in this DeepView share some common themes around the need to make healthcare smarter by being agile, connected and collaborative. These organizations identified opportunities to improve patient care and advance medical research and drug development by creating stronger connections between people, the information they need to be effective and the business processes they need to follow.

Another common thread is the use of service-oriented technology as the foundation for building a smart IT platform to support making healthcare smarter. With an SOA approach, these organizations have been able to integrate silos of information and IT infrastructure to create a more agile and connected business environment capable of adapting to continuous change.

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