Mayo Clinic takes a giant step toward information-based medicine.

Overview

- ***Challenge***
  As one of the world's top clinical research organizations, Mayo Clinic is on a constant quest to improve the way it diagnoses and treats illness.
- ***Why Become an On Demand Business?***
  Mayo is transforming its research and care practices—making them more targeted, efficient and effective—by integrating biomedical data into its core processes. Bridging clinical data silos within and outside the organization is key, as is support for standards.
- ***Solution***
  IBM and the Mayo Clinic embarked on a collaboration to realize a shared vision of information-based medicine. They built an integrated Clinical Genomics information infrastructure, containing demographic, diagnostic, physiological and genomic data whose security meets HIPAA and federally mandated Institutional Review Board requirements for patient data confidentiality.
- ***Key Benefits***
  - *In identifying potential study recruits, Mayo is able to achieve in seconds what had taken months to achieve.*
  - *Realtime access to clinical, genomic and proteomic data will enable clinicians to prescribe more targeted, effective treatments.*

Employing more than 46,800, Mayo Clinic has facilities in Rochester, Minn., Scottsdale, Ariz. and Jacksonville, Fla., as well as a network of clinics and hospitals in 64 communities in southern Minnesota, northern Iowa, and western Wisconsin.

Within the U.S., the healthcare sector stands out for the magnitude and breadth of its research and, perhaps most of all, for its dramatic advances in understanding and treating illness. A key underpinning of these advances has been the circular flow of knowledge between clinical research and clinical care—clinical researchers distill knowledge from clinical data such as patient records, while clinicians put clinical research into practice. Though this interplay has been long established, recent trends have pushed the possibilities for medical advances to an entirely new level. One factor has been the explosive growth in the volume of clinical data held by hospitals, driven

> *"We are at a point where we can achieve more in the next 10 years than we've achieved in the last 100, and we see in IBM a collaborator with a unique capacity to deliver expertise and innovation."*
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> – *Denis Cortese, M.D., president and CEO, Mayo Clinic*

On Demand Business Benefits

- Realtime access to clinical, genomic and proteomic data will enable clinicians to prescribe more targeted, effective treatments, producing better outcomes and lower costs over the long term.
- A drastic reduction in the recruitment cycle (from months to days) will allow Mayo to fill studies more quickly, shortening the time it takes to complete a study and speeding the course of research.
- The ability to integrate internal clinical data with external databases—and access it realtime—will enable researchers to correlate genetic data with treatment effectiveness, allowing more targeted treatments.
- Open architecture enables Mayo Clinic to easily deploy new analytical and clinical decision-support tools

largely by an increase in the number and types of clinical tests available to doctors. Another has been the steady shift from paper to electronic medical records storage, a trend which—by making the growing reams of patient data more portable—also makes it vastly more practical to synthesize and analyze on a large scale. This enables researchers to determine, for example, what types of treatment have been effective for a very specific set of symptoms and conditions, and which have not. This vision comes full circle when clinicians leverage the information gained from large-scale analysis to customize the treatment of individual patients based on the specifics of their condition and background, a contrast to the protocol-driven treatment plans that prevail today. Known as information-based medicine, this practice is a key goal of clinical-research collaboration, and ultimately the future of healthcare delivery.

As a world leader in applied medical research and an innovator in the area of new treatments, Mayo Clinic (www.mayoclinic.org) saw a natural role for itself in advancing the vision of information-based medicine. Staffed by nearly 2,000 physicians and scientists, the clinic's Rochester, Minnesota facility had built a reputation not only for the quality of its care, education and research, but also for its commitment to applying leading-edge medical information technology—a trait exemplified by its early adoption of electronic medical records. As part of its constant drive to innovate, the leadership and board at Mayo Clinic looked around and saw a technology environment in flux. On the medical side, breakthroughs in genomics (gene arrays, genotyping, etc.) and proteomics (the science of protein behavior that builds on genomics) promised a leap in the understanding of diseases at a molecular level. At the same time, advances in medical information technology, such as the availability of powerful integration tools and the proliferation of open and industry standards, had produced a parallel breakthrough in the ability to federate data of different types and from different sources. Mayo Clinic looked at these developments and saw its base of 4.4 million electronic patient records—whose disparate formats and dispersion across the enterprise had made them difficult to leverage for research purposes—as a wealth of information that could finally be tapped on a large scale. In these combined factors, Mayo Clinic saw the opportunity to respond more rapidly to medical knowledge as it changed and grew, and in so doing transform the way it diagnoses and treats diseases through the use of information-based medicine.

"The ability to correlate clinical data with a patient's genomic information will increasingly allow us to identify the most effective treatment for an individual early in the course of medical therapy, rather than relying on trial and error."

– *Dr. Nina Schwenk, chair of the Mayo Foundation IT Committee*

But Mayo Clinic faces a number of challenges to realizing its vision. While standards and integration tools would help, the task of pulling

together the data into a format that is usable by clinicians and researchers remains daunting in its complexity. Security is also critical, since the plan revolves around the aggregation and analysis of patient data. While HIPAA [the Health Insurance Portability and Accountability Act] provides a rough guideline for maintaining patient data confidentiality, the sheer volume of data and the broad number of end users calls for a highly secure and granular level of authentication as well as a way to monitor patient data access after the fact. The final challenge is the need to build a system that has the flexibility to accommodate new data inputs as they arise, as well as output to specialized third-party analytical and clinical decision-support tools, thus enabling it to capitalize on the best available software tools on the market.

Knowing when to collaborate

Though Mayo Clinic had a long tradition of technological self-reliance in support of its practice innovation initiatives, it realized that the scale and complexity of the initiative required collaboration from the outside. While world-class technology and integration skills were naturally viewed as critical to success, the need for strong process level expertise made healthcare and life sciences domain knowledge equally important criteria. Mayo Clinic ultimately selected IBM Life Sciences due to its strength in both areas. Working alongside Mayo Clinic's staff, the IBM team (which also included staff from IBM Systems Group) began the project by creating an inventory of key data sources, the most important of which were found to be electronic medical records, lab test results and billing data (including patient demographics and standard diagnostic codes).

The team then created a user-friendly data virtualization engine and query tool that provides authorized clinicians and researchers with access to unprecedented amounts of patient information. The tool enables users to build either menu-based or natural language queries, through which they can specify parameters like symptoms, diagnostic codes or test result ranges. Results—in the form of patient cases—are returned in realtime. Mayo is now in the process of expanding the solution by establishing seamless XML-based links with very large external sources of genomic and proteomic data, such as the National Cancer Institute. When it acquires this capability, Mayo Clinic will have crossed a key threshold on the path to true information-based medicine. It will be able to correlate genetic data with treatment effectiveness—a practice known as Clinical Genomics—instantly, not over the course of months or years. This, and the ability to create patient profiles at a genetic level, will enable Mayo Clinic to deliver highly targeted treatments.

Ready for growth

The solution's architecture reflects the need for openness and resiliency. The data warehouse runs on the IBM WebSphere Application Server platform on an IBM eServer pSeries, with the data stored on an IBM TotalStorage Enterprise

Key Components

Software

- IBM WebSphere® Application Server
- IBM DB2® Universal Database™ - Enterprise Server Edition

Servers

- IBM eServer™ pSeries® 650
- IBM eServer pSeries 690
- IBM TotalStorage® Enterprise Storage Server®

Services

- IBM Healthcare and Life Sciences
- IBM Systems Group

Storage Server system running IBM DB2 Enterprise Server. Another pSeries serves as a front end development server and application server. To support affordable growth as usage rises, the pSeries servers include the Capacity Upgrade on Demand feature, which enables Mayo Clinic to add capacity on a pay-per-use basis. Thus, as Mayo Clinic expands the deployment from its Rochester campus to its broader enterprise, it will be able to maintain high levels of performance while minimizing upfront costs. The solution's open application architecture, based on a Web services model, was also designed to support flexible growth. While the solution links legacy applications to the data warehouse via XML, new applications—such as clinical decision-support applications used by doctors, or visualization tools used by researchers—can be readily deployed as plug-ins through the Web services model. The solution's robust authentication scheme enables Mayo Clinic to define access down to the level of specific researcher or clinician, while a usage auditing capability, custom designed by IBM, logs every action taken by users of the system.

Providing realtime access to clinical data, Mayo Clinic's system is expected to produce dramatic improvements in the efficiency and effectiveness of treatments. On the research side, faster access will cut the time required to gather and analyze existing stores of data, thus lowering the hurdles to achieving breakthroughs. In the area of new research, the system will allow for higher efficiencies in the complex task of recruiting new study participants. In one recent case, a list of qualified study candidates generated by full-time researchers working months took less than a minute using the new system.

Mayo Clinic and IBM share a common vision for the future of medicine. This is a future where medical practice is improved by knowledge generated from the integration of diverse clinical and biomedical data, leading to more effective and targeted treatments…and ultimately personalized medicine.

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IBM Corporation
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New Orchard Road
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