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Kettering Medical Center Helps Physicians Help Themselves

Providing Ubiquitous Access to Up-to-Date Test Results

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By Ronni T. Marshak

Executive Summary

For Kettering Medical Center (KMC), a non-profit, acute care, regional healthcare network, the direct customer is the physician or another clinical medical staff member who treats patients. Prior to 1997, clinical staff had to navigate numerous test-based medical systems to obtain laboratory and other test results. The only other option was to call the various labs and medical records offices and ask staff members for this information. Both methods were time-consuming and complicated.

In response to physicians' requests for an improved method of accessing patient information, KMC built the Clinical Workstation, an e-business Web-based solution that consolidates information from various legacy medical databases, such as pathology, electrocardiography, and radiology. Using MQSeries products, IBM Global Services brought together data that resides in IMS systems on an IBM mainframe platform. Working in partnership with Kettering, the IBM team designed an easy-to-use, custom-built, Java-based front end on an NT server.

As a result, clinical medical staff, including senior physicians, residents, nurses, and medical students, have 24-hour access to all results, accessible from any standard Web browser.

Customers.com Critical Success Factors in the Kettering Medical Center Story			
	Target the right customers	☆	Let customers help themselves
	Own the customer's total experience	✓	Help customers do their jobs
☆	Streamline business processes that impact the customer		Deliver personalized service
	Provide a 360º view of the customer relationship		Foster community
☆	= Featured in this discussion	✓	= Touched on in this discussion

☆Streamline Business Processes That Impact the Customer

By providing easy-to-use 24x7 access to up-to-date information, Kettering has eliminated time and effort from the process of obtaining lab results, thus streamlining that important process for its customers, the medical staff, and the physician's end customer, the patient.

☆Let Customers Help Themselves

Clinical personnel can access data at any time from anywhere using a standard Web browser, helping themselves to test results at their convenience.

✓Help Customers Do Their Jobs

By having the latest information available through the self-service Clinical Workstation, physicians can make the proper diagnosis and prescribe the appropriate care.

KETTERING MEDICAL HELPS PHYSICIANS HELP THEMSELVES

Rather than wading through piles of papers, making numerous phone calls, or slogging through a plethora of nongraphical databases, clinical medical staff can just log onto the Clinical Workstation to obtain up-to-date test results in a friendly, graphical, Web-based, point-and-click environment that embodies key principles of e-business: connecting existing IT infrastructure and information and serving it up via the intranet.

Setting the Stage

What is Kettering Medical Center?

NONPROFIT ACUTE CARE. Kettering Medical Center is a comprehensive, nonprofit, regional healthcare network specializing in acute care. The Kettering network includes Kettering Memorial and Sycamore hospitals, the Kettering College of Medical Arts, Sycamore Retirement Community, and Kettering Affiliated Health Systems. Affiliated with the Adventist Health Care System, KMC is also a member of the Alliance for Health of Southwest Ohio.

A WIDE RANGE OF SERVICES. Under the guidance of president and chief executive officer Francisco J. Perez, Kettering offers services including ambulatory care, neurology, pulmonary care, ophthalmology, obstetrics and newborn care, gynecology, gastroenterology, psychiatry (both adult and adolescent), physical medicine, and rehabilitation. KMC is recognized as a major cardiac care center, is noted for its comprehensive cancer program, and is known for pioneering high-technology medicine, such as positron emission tomography and magnetic resonance imaging. KMC provides many types of surgical procedures, including emergency surgery, open heart surgery, neurosurgery, plastic surgery, and orthopedic, ophthalmologic, gynecologic, cardiothoracic, urology, laser, and endoscopic surgery. Supporting KMC's surgical services are specialized intensive care units (ICUs) that care for general ICU, neurosurgical, cardiac, cardiothoracic, and medical pulmonary patients, and at-risk newborns.

KMC hospitals have approximately 650 beds for patients and support almost 850 physicians. Over 600 medical students are trained at KMC facilities, and the network boasts 650 volunteers.

Following the Founder's Example of Work, Ingenuity, and Technology

The Kettering Medical Center was named for Charles F. Kettering, a renowned screwdriver-and-pliers inventor whose philosophy, even today, continues to impact all aspects of our society. At his death in 1958, Kettering was a co-holder of more than 140 patents, possessed honorary doctorates from nearly 30 universities, and was credited with inventing the electric cash register, electric auto ignition, Freon (used in refrigerators and air conditioners), and safety glass. Kettering believed strongly in the combination of hard work, ingenuity, and technology to make the world a better place.

Following his model, KMC has been working to support its clinical staff, and, by extension, its patients, with innovative technological solutions to assist in medical care. An excellent example of this can be found in the two-year-old Clinical Workstation project, which helps physicians effectively diagnose and treat patients by providing instantaneous and easy access to laboratory results and other relevant medical information at any time from any location.

Supporting Physicians and Clinical Professionals

The end customers for the Kettering Medical facilities and services are the patients who are given needed care. But the physicians and other clinical medical professionals who refer and treat the patients are key customers of the Center. As there are many medical facilities in the Ohio area that are trying to attract the best doctors and

nurses to their services, KMC is dedicated not only to providing the best healthcare in a community hospital setting but also to providing excellent services to attending physicians, nurses, technicians, residents, and medical students. It is this population of customers that constitute the principal users of the Clinical Workstation.

Opportunity: Provide Consolidated Access to Test Results

OLD METHODS TOO TIME-CONSUMING. Conducting laboratory tests is an important part of comprehensive heath care. But not only must the tests be conducted but also results must be delivered to the medical staff who interpret them and ultimately communicate their meaning to the patient. As in any medical facility, different types of tests are conducted in different departments, and the results are maintained on different systems. Until October 1997, a physician could call each department, such as radiology or pathology, and ask for results, sometimes playing telephone tag or waiting on hold while the results were located. Or she could wade through papers searching for the specific information needed, slog through the different text-based medical systems, typing in commands and navigating layers of cascading menus. Not the most effective use of a physician's valuable time!

A CLEAR CUSTOMER MANDATE. For a number of years, the Kettering physicians have wanted some sort of automated system where they can easily get laboratory results and other patient-related information without having to go through a laborious process.

In an effort to support the physicians and other caregivers who are part of the Kettering team, the medical center sought to provide a mechanism by which the clinicians could get immediate access to laboratory results and x-rays from any location at any time.

CREATING A CLINICAL WORKSTATION. As a direct response to this clear customer request, Kettering began working on the Clinical Workstation, an enterprise-wide clinical repository with an easy-to-use Web front end. The goal of this repository was to have a single place to find and maintain clinical information so that medical staff could make effective decisions based on all the most recent data.

Business Benefits

- By building a Java-based front end to multiple underlying data sources, Kettering has provided a familiar Web-browser interface to critical laboratory results and other medical information. Doctors, nurses, and medical students can now access this vital information whenever and wherever they need it.
- The time demands on laboratory personnel have decreased because the technicians don't need to constantly answer telephone requests for test results.
- With the consolidated database underlying the Clinical Workstation, Kettering can now begin to maintain comprehensive medical information in a single repository. This makes it easier to do analysis of data, identifying patterns in medical results by individual patient as well as in demographic groupings.

Leveraging Experience with the Web

Early in the planning process, Kettering explored data warehousing solutions for establishing the clinical repository. Although the determination was made that this was an excellent approach, the technology wasn't sufficiently mature and there weren't many medical facilities following that course of action. In addition, the costs were prohibitive. So rather than looking at a three-to-five year data warehousing plan with uncertain funding for a major consolidation effort, KMC chose to follow the route of smaller investments, leveraging the tools already in place.

Kettering had been an early pioneer in Web experimentation and had determined that a browser interface would be the best way to deliver up-to-date lab information to the medical staff. Not only are Web browsers cost-effective front ends to legacy systems, but there was also a growing population of medical professionals who were becoming increasingly Web-savvy on their own. Thus, providing a Web-based solution would require little investment in training.

Further, a number of other technology projects were underway investigating the possibility of providing Web access to a wealth of different facility information, including:

- Medical library information
- Surgery schedule
- Searchable drug database
- Formulary (an in-house catalog of drugs on hand)

And, as an added benefit of a Web-based system, new applications could be added without incurring any additional training.

EVOLVING THE TECHNICAL INFRASTRUCTURE: ENABLING TECHNOLOGIES

Working together, Kettering and IBM Global Services took advantage of IBM MQSeries to tie together the different pieces of the underlying infrastructure upon which the Clinical Workstation was built, providing connectivity between the disparate medical systems, the client Web browser, and the NT server. (See the accompanying illustration.)

The NT server hosted both Java and MQ Client software, which connected to an MQ Server, also resident on the NT machine. This NT-based MQ Server connected to another MQ Server that sat on the host IBM 9121 mainframe, which hosted the clinical repository (IMS database).

To tie into the front end, IBM Global Services used its expertise in Java development to build Java applets that sat on the NT server to communicate between the Web server and the MQ client. IBM team members shared their experience with Kettering staff, training them so that they could continue with future Java development and support.

The solution is intranet based, with the only client access being from a Netscape Web browser.

For example, another project at KMC that leverages Web access is called the Grease Board. In the emergency room, as in many emergency rooms, staff keep track of patients admitted and treated on an actual grease board (whiteboard). This works well because all the information is available in a single glance. However, the information is also out in the open where anyone can see it.

In an effort to improve privacy while still providing one-glance accessibility, KMC is providing a real-time application that updates six different workstations positioned around the ER for easy access by authorized staff. The information provided is not the medical record—it just keeps track of who came in, who took care of the patient, what was wrong, and where the patient is currently. The online Grease Board is in use now, and, according to Bill Perry, registered nurse and member of the Clinical Workstation project team, it has been "wildly successful." Like the Clinical Workstation, it has trained the staff to use the Web front end and started them thinking about what other information might be more valuable when accessible online.

The Clinical Workstation: Pulling It All Together

INFORMATION FROM A VARIETY OF SOURCES. The Clinical Workstation takes text-based data from a number of underlying legacy repositories, including:

- **Clinical Laboratory Results,** the findings from standard lab tests, such as blood workups
- **Pathology Results,** the diagnosis and findings on cancerous tissue and related tests
- **Electrocardiography,** the electronic measurement of heart patterns
- **Radiology,** x-ray results
- **Health Information Services,** the transcriptions of medical records dictated by physicians upon patient admission

The data from these repositories are fed into a common IBM IMS database, and users can access the results from a Java-based, point-and-click browser front end. According to Bill Perry, the Clinical Workstation was designed to be very simple to use: "We wanted a straightforward system. There aren't any rules for usage other than tight security requirements. And we wanted to keep it simple so that it would be easy to add new follow-on systems to the same front end."

IBM CHOSEN AS THE PARTNER FOR DEVELOPMENT. Kettering recognized, however, that even though the front-end design was to be simple, the integration and security requirements were not. The facility needed assistance in getting the right information to the Web browser front end with the right level of protection. Because the application would be looking into highly confidential data sources containing patient information, access security was of the utmost importance.

So Kettering set about finding a partner in the development of the Clinical Workstation. Several consultants were brought in to determine which would be the best match for the work to be done. IBM Global Services was selected for its quick understanding of what Kettering hoped to achieve, its enthusiastic endorsement of leveraging a Web browser front end, and its experience in Java development and building gateways between legacy systems and the Web. The choice has worked out well; Kettering has been delighted with IBM's efforts. As Dan Townsend, technical integration manager Integration Systems and technical project leader for the team, stated, "It was as if IBM was a member of our department!"

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CRITERIA FOR SUCCESS. Assisting the clinical staff by providing timely and accurate information for treating patients is such a core concern of Kettering Medical that it identified volume of usage as the sole measurement of success of the Clinical Workstation system. And, indeed, the system is being used regularly, and to great effect, by senior physicians as well as residents and medical students.

Clinical Workstation Architecture

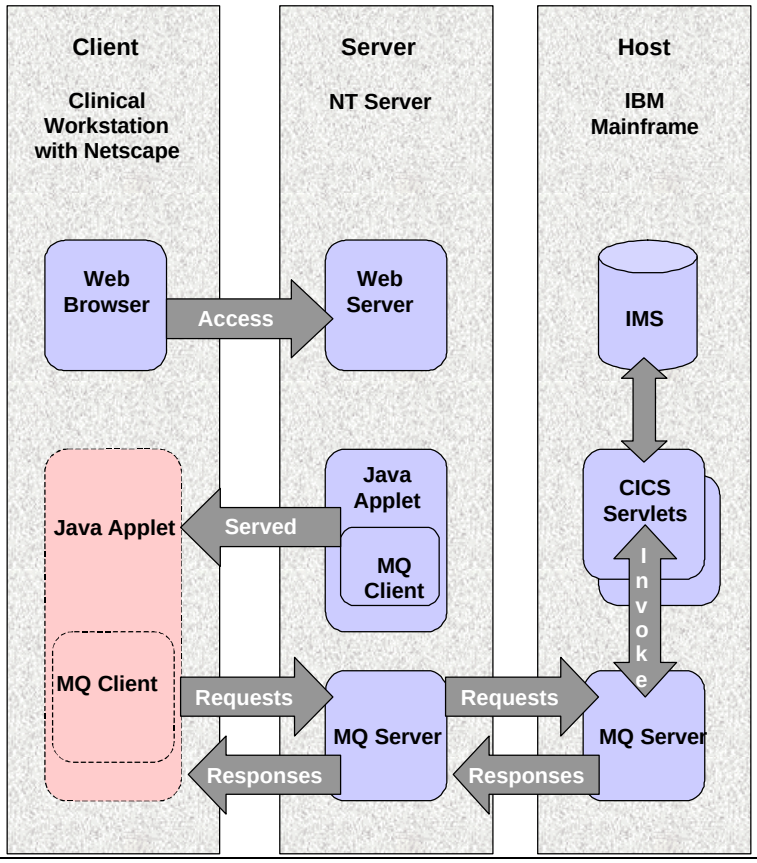

Illustration. A Java applet uses IBM's MQSeries to access information on the host-based IMS database.

EVOLVING THE TECHNICAL INFRASTRUCTURE: INFORMATION ASSETS

To bring Kettering's clinical data into the Clinical Workstation's consolidated IMS database, IBM Global Services and Kettering's IT staff wrote IMS and CICS servlets as the interface link between the MQ Server on the mainframe and the IMS database. The servlets are COBOL programs that process each request made by MQSeries, verify security, search and retrieve legacy data from the IMS database, and pass this data back to MQSeries.

The Clinical Workstation's IMS database is fed by a variety of different clinical systems, supporting the following operations:

- Clinical laboratory results
- Pathology laboratory results
- Electrocardiography system
- Radiology
- Health information services

In all of these systems, medical results are dictated and transcribed by a third-party service. The transcribed reports are transmitted to Datagate, a system from Software Technology Corporation, which sits on an IBM RS/6000. The transmission protocol is HL 7, a standard for sharing medical information among a number of systems. From Datagate, the information is transmitted to the IBM system, where it is stored in the IMS Clinical Data Repository.

Customer demographic information is maintained in a legacy IMS database application called MedCare. The Clinical Workstation provides a GUI front end to this data.

Kettering plans to migrate the IMS repository to DB2 over the next year. It is also implementing Open MVS to leverage the IBM mainframe as a Web server. This will allow the client to connect to the mainframe host to access the clinical data, eliminating the need for the NT server and the MQSeries middleware, reducing operating costs, and simplifying technical support.

The e-business Initiative

Organizational Decisions

FORMING A CROSS-FUNCTIONAL TEAM. Although the Clinical Workstation project was funded by the IT department, the technologists worked closely with representatives of the medical staff to ensure that the solution would meet the clinicians' needs.

The medical team was represented by a five-member physician group and three members of the nursing staff, including Bill Perry. This team was charged with providing the clinical expertise to help determine where technology would most effectively be put to use. Two of the nurses on the team had been actively involved in the development of a clinical information system in Kettering's critical care unit and therefore had a good understanding of how the technology could work to best advantage. These nurses stayed actively involved during configuration and deployment of the Clinical Workstation.

IT was represented by Rick Moore, the director, and Pam Holliday, applications manager, who brought in the appropriate programmers and analysts as the Clinical Workstation was integrated with various legacy systems.

Rounding out the team were the representatives of IBM Global Services, which provided the technical expertise to pull all the pieces together and create an integrated solution.

HIGH-LEVEL SPONSORSHIP. A key factor in getting this type of project off the ground is having a high-level sponsor who champions the endeavor within the organization and provides the organizational clout to keep the project on the front burner. For Kettering, this champion was Roy Chew, vice president of Administration, who was dedicated to ensuring that the right people got the right information when they needed it.

Investment

The development of the Clinical Workstation was a six-month project. The Kettering IT team included about six people at any one time, dedicating from 50 to 75 percent of their time to this project. IBM had a contract for 1500 hours and four to five consultants working on the project. In addition, the clinical members of the team spent many hours planning and critiquing the efforts.

Kettering spent a total of $432,000 to complete the development work.

Results

A Simple Solution Masking Underlying Integration Efforts

The Clinical Workstation is an excellent example of a deceptively simple solution: On the surface—the Java-based front end—information access is straightforward, but the integration efforts underneath ensure that the system provides up-to-date information to the right people when they need it. The joint development team of Kettering's IT department and IBM Global Services were able to use IBM products and expertise to achieve seamless integration while hiding the complexity from the user community.

Positive Reaction from Clinicians

According to Bill Perry, the Clinical Workstation project proved its worth by its relatively low cost of implementation and maintenance and the obvious value it was providing to clinical staff. Aside from general positive reactions to the capability of the Clinical Workstation, the proof is in the usage.

The clinical population at the various Kettering Medical facilities and services are actively using the Clinical Workstation. This includes senior attending physicians as well as residents and medical students. Only a small core of attending physicians use the system regularly; others rely on residents to obtain test results. But almost all senior medical staff use the system on occasion, especially in situations when time is of the essence. The Center is completely dedicated to providing this benefit to its staff and patients and believes the medical advantages being realized are proof of the value of the system.

All residents and medical students are trained in the system when they come on board, and residents in particular use the Clinical Workstation regularly.

Analyzing the Consolidated Data

Since the system was first implemented in 1997 and was populated with data from 1996 on, no information has been purged. The current plan is to maintain all information forever. This allows KMC to do some interesting analysis of the data, identifying patterns in test results and following a single patient over a lifetime of treatment.

Unexpected Benefit: Unburdening Laboratory Staff

An unarticulated yet very real benefit to this e-business initiative has been a reduced burden on laboratory staff. By providing lab results online, accessible from anywhere at any time, laboratory personnel are relieved from the continual telephone inquiries from medical staff regarding the outcome of tests. In all but exceptional cases, the results are obtained electronically.

IBM's Value

IBM's definition of e-business is IT + Internet—that is, leveraging the power of existing systems and the opportunity of the Internet to transform a company's business.

IBM identifies four specific areas of value that it provides for its e-business customers:

✓	It's about business, not just technology.
✓	Start simple. Grow fast.
✓	Build on what you have.
✓	Expertise you can trust.

In the Kettering case, IBM made major contributions in all these areas. According to project team member Bill Perry, IBM, which had worked with Kettering before, "had an excellent reputation, leading to a trusting relationship." The IBM Global Services team understood that the Clinical Workstation was targeted at a medical audience, not a technical one, who needed to have the problem solved without technology getting in the way.

By leveraging the existing investment in legacy information and the clinicians' familiarity and comfort with the Web interface, IBM allowed Kettering to build on existing technology and skills.

Finally, the Clinical Workstation project was designed to be simple—simple to develop and simple to use. As new requirements arise, Kettering and IBM can work together to add these capabilities to this project or other follow-on systems.

Future Directions

Expand the Web-Based Information Services

KMC plans to provide more knowledge-based resources in the future, all accessed via Web browser, such as an online pharmacology database that will provide physicians with information on drug interactions and the relative cost of different drug treatments. The capability will also include the ability for the doctor to print out this information for patients.

Leveraging the IBM Mainframe as the Web Server

Over the next year, Kettering plans to implement Open MVS to leverage the IBM mainframe as a Web server, eliminating the need for middleware, reducing operating costs, and simplifying technical support.

LESSONS LEARNED FROM CASE PROVIDER STORY

1. The Kettering Clinical Workstation truly embodies e-business, as it enhances its support of clinical staff by leveraging existing information and IT infrastructure with intranet access.

2. Work with a partner that shares your vision. IBM Global Services was an invaluable addition to the Kettering team because of its understanding of Kettering's priorities, technical implementation, and goals. According to technical project leader Dan Townsend, "Working with IBM Global Services was like expanding the in-house team."

3. Leverage existing infrastructure. The information provided by the Clinical Workstation has always resided in the IBM mainframe, and it remains there, benefiting from capabilities, such as security, that the mainframe applications provide. By bringing all the data together for Web Access via the MQSeries software, Kettering did not have to design and develop new medical systems.

4. Provide a simple solution. There are no fancy rules or processes built into the Clinical Workstation. It is designed to be very simple to learn and use and to solve only the information access problem. Because IBM Global Services were used to provide the underlying connectivity, the complexity is hidden from the users accessing the Java front end.

5. Leverage the front end. The Clinical Workstation is only one of the Web front-end projects that KMC is working on. The center is leveraging the medical staff's experience with Web access by providing a number of other applications with the same interface.

TAKEAWAYS FROM CASE PROVIDER STORY

1. Leveraging familiar technology, such as Web browsers, in an e-business solution is strategic to getting nontechnical users comfortable with solutions.

2. Customer satisfaction is a justifiable return on investment. No solution is a success unless people are willing and excited to use it.

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