Case Study

When IT Matters:

Improving Care Delivery and Patient Outcomes through Technology

Texas Children's Hospital

About CHIME

The College of Healthcare Information Management Executives (CHIME) is the professional association for chief information officers and other senior healthcare IT leaders. CHIME enables its members to collaborate; exchange ideas; and advocate the effective use of information management to improve health and healthcare in the communities they serve.

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Teams and Tools Unlock Millions in Savings at Texas Children's

Myra Davis

Myra Davis is senior vice president and CIO for the Houston-based Texas Children's Hospital. In 2013, Davis was the recipient of the CHIME-AHA Transformational Leadership Award, which honors an organization that has excelled in developing and deploying transformational information technology that improves the delivery of care and streamlines administrative services.

For Terri Brown, a research specialist and assistant director of data support at Texas Children's Hospital, using EHR data for clinical research was initially quite cumbersome.

The process involved report requests to IT, followed by weeks of waiting. Should Brown necessitate further evaluation of the results, another report request would have to be submitted to the IT department, and the weeks-long cycle would repeat again.

Eventually, Brown was faced with a tough predicament, one that would seem to contradict the benefits of possessing electronic data. "Is it worth it to have an extra element built into a report or should I just do a hundred manual chart reviews instead of waiting weeks for the report?" she recalled.

That dilemma, and many others like it, struck Myra Davis, senior vice president and CIO for the Houston-based pediatric hospital. She was frustrated that the IT department had become a "report factory," and she worried about clinicians' disaffection with the circuitous route needed to extract intelligence from electronic records.

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*- Terri Brown, Research Specialist and Assistant
  Director of Data Support*

"Our clinicians thought that the EHR was a silver bullet to get the data they needed," she said. "The comments I would hear were, 'I can't get the right data,' or 'The IT staff doesn't understand what I need from the records.' It created nothing but frustration."

Then, Texas Children's Hospital made some radical changes. The hospital began work on an enterprise-wide data warehouse solution to implement a clinical, analytical and process-based framework. IT staff and clinicians started working in cross-functional teams, using new analytics applications that enabled them to better visualize results in minutes, opposed to months.

"The data has been wonderful; the platform that's been chosen is ideal. It's great to be in a meeting to slice and dice the data," Brown said. "When it used to take three months to get a report, now within 30 minutes you have such a great understanding of the data. It takes away the false leads. It tells you what the source of truth is for how we have changed care

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The Perils and Promise of Research

Expectations are high for the use of clinical data systems in healthcare. The federal government has provided billions in incentive payments to generate widespread use and adoption of EHRs. Those implementing the systems are counting on EHRs to provide useful information, enabling safer and more effective care.

While the strength of EHR systems is recording information in digital formats, analyzing the data can be difficult. Furthermore, electronic clinical information is not easily matched with financial and administrative data, adding more complexity to the analytic process.

Using EHR data is rarely a user-friendly process. Report-producing applications require technical acumen beyond the ability of most busy clinicians. And it's just as rare to find an IT staff member who understands the nuances of the research that clinicians want to pursue.

This type of conundrum stood in the way of some quality initiatives at Texas Children's, which sought to improve the quality and coordination of care it provided to patients. Executives at the facility also knew that future reimbursement changes would increase the need to improve efficiency and better treat patient populations with common diseases, such as asthma, diabetes and pneumonia, which are costly to treat when patients' care is not carefully managed.

After Texas Children's implemented its EHR system in 2008, the noise started, as Davis put it. "I was hearing from staff that, 'I can't get the data I need,' or 'The reports don't work.' The more we implemented, the louder the noise got," she said.

With data emerging from different systems within the hospital, researchers also faced limitations conducting analysis. "The data fields were not all the same, and there was no common language between the systems," Davis said. "That was the 'aha moment.' You can't underestimate that the EHR is not a silver bullet, that it's only the beginning of the journey."

Moving to a Data Warehouse Approach

The organization realized it needed something beyond the records system if it was going to succeed in using the data on its patients to achieve quality improvement, said Charles Macias, MD, MPH, an associate professor of pediatrics at Baylor College of Medicine and director of both the Center for Clinical Effectiveness and the Evidence-Based Outcomes Center at Baylor/Texas Children's and co-director of the clinical systems integration program that houses the efforts surrounding the enterprise data warehouse.

A site visit to Intermountain Healthcare by Mary Jo Andre, Texas Children's senior vice president of quality, and members of her team was pivotal in changing the direction of the hospital's data initiatives. There, they saw the potential for using EHR data within an enterprise-wide data warehouse to mesh clinical results with financial and administrative data, enabling better and faster research.

Texas Children's began looking for a vendor with data warehousing capabilities. They began discussions with Health Catalyst, which uses a structured approach to acquire data from source systems within an organization and store that data in an optimized fashion so that it's more easily analyzed, translated, and applied in healthcare settings.

"Their approach from a technical perspective was very interesting," said John Henderson, the lead on Texas Children's EDW technical team. But Health Catalyst had more than a big bucket to hold data – the vendor also offered analysis tools that enabled teams of people to work together and see the results of drill-down data scenarios. The analytics applications enable users to prioritize, track and interpret iterative improvement, a key to establishing a baseline of performance and ensuring sustainable improvement.

> **Realized Cost Savings!**
> Davis estimates that data analysis from the data warehouse costs about 70 percent less to produce than a report direct from the EHR data

The enterprise-wide data warehouse is a large step toward creating a repository of information that enables a consistent view of data from many sources within the organization. That, as a basis, can help bolster research findings that can be backed up by the actual experience of the organization.

The data in the warehouse can be better analyzed through the use of visualization technology. Rather than relying on a process that involves report requests that need back-office programming, the visualizations of information from the data warehouse can be produced on the fly, during team meetings. This iterative approach to data management enables real-time collaborative team efforts to create subject area initiatives in which data sources, definitions, and access are created and crafted into visualizations, using software that permits point-and-click manipulation.

Davis estimates that data analysis from the data warehouse costs about 70 percent less to produce than a report direct from the EHR data; that's because report requests before the EDW typically required IT staff to manually pull information from a variety of IT systems outside of the clinical system. Because of the visualization capabilities of the technology, one visualization is equivalent to about 10 EHR-generated reports, she added. The economies of scale grow as future years of access needed for quality improvement activities obviate the need for additional reports.

Moving to a Team-Based Approach

Texas Children's Hospital has formed permanent teams that work together on quality improvement. The teams draw together staff from various areas of the hospital to look at how workflows and processes impact the quality of patient care and the cost of providing it.

The adoption of teams comes from a cultural shift that reflects the belief that meaningful change in a healthcare organization can't be achieved if that change is dictated by IT, the clinical staff or hospital administrators. All three must be in discussions, looking at the data and the impact of any changes.

"The reason I really like this model is that it cannot be IT-led," Davis said. "It brings the world of quality and IT together. That's the marriage we were looking for."

"The IT team, clinical people, and finance and operations staff all need to be in lock step about what they need to know," said Frances Kelly, director of quality and safety at the Texas Children's Pavilion for Women. "You can be looking at length of stay or bed utilization or any impact of what you do. When you think about quality, it requires that you stay together in lock step; it's about the data that impacts the whole disease process."

The teams require growth of all its members. IT staff manipulating the visualization technology must gain an understanding of the complexity of clinical cases and the variations that the quality improvement and outcomes analysis staff are seeking to isolate. Clinicians on the teams have to be ready to question standard practices and learn how the analytics applications can help tease out findings that improve care delivery and/or reduce costs.

"We all see that healthcare is changing and that we need to do a better job, but in the past, we didn't have any idea what kind of job we were doing," said Robert Moore, MD, a pediatric pulmonologist who has been a member of several care process improvement teams. "But is what we're doing effective? Is it the best way? We never asked those questions. Learning how to interrogate the database took a lot of time; we speak very different languages, and often, we weren't asking the same thing at all.

"The beauty of having IT and clinical sides in the room is that you can spend the time needed to develop the cohort that will actually answer the questions you want to have answered," he added.

Preconceived ideas about best practice sometimes didn't hold up under the weight of data, said Monica Lopez, MD, an attending surgeon in the pediatric surgery service of the hospital. "Once we visualized the data, things came up that we didn't expect," she said. "We found huge areas that we could develop to improve outcomes."

The importance of wide participation in teams by a variety of disciplines is important beyond the investigation process, Macias said. "It's a critical piece of what drives improvements in outcomes," he said. "We didn't want it to be about what processes we put in place, but how do we change outcomes? There's a recognition that IT should never change the clinical workflow, and the clinical realm should never dictate to IT what the application should look like.

"The success of this strategy is the fusion between what we know about best science and the transformation enabled by data," he continued. "If we can get it real-time into the hands of the provider, then we can have the operations and process intervention. If you're going to change workflow in an organization like this, you have to be able to explain how it represents the best science available. This has meant a huge governance and workflow change here."

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> *Associate professor of pediatrics at Baylor College of Medicine*
> *Director, Center for Clinical Effectiveness and the Evidence-Based*
> *Outcomes Center at Baylor/Texas Children's*

Achieving Improved Care and Savings

After implementing the enterprise-wide data warehouse in September 2011, Texas Children's started focusing efforts on asthma, a condition affecting a significant percentage of its patients. It also is a disease of personal significance for Macias, who saw firsthand the need to develop an integrated, data-driven care plan as a result of an emergency department encounter with a 5-year-old patient with uncontrolled asthma in 2006 for whom Texas Children's had failed to provide high-quality care in the course of several visits.

A cross-functional workgroup – including physicians, nurses and others knowledgeable in patient safety, quality improvement, finance and IT – was created to assess and manage acute asthma, looking at an encounter from the time patients arrived in the emergency department until they were discharged from the hospital and returned for self management or community based follow-up.

Initial analysis identified a higher-than-normal volume of chest X-rays being administered to young asthma patients. Rather than requesting a report to look for reasons for X-ray requests, the team was able to use the analytic capabilities of the EDW to study the data. Texas Children's physicians were ordering X-rays for 65 percent of their patients, compared with national benchmarks of 35 percent or evidence-based practice that suggested that X-rays would be useful for detecting pneumonia in only about 5 percent of patients. The IT team traced the anomaly to an order set within the EHR that lacked decision support and a gap in provider education, and quickly rewrote the order set to reflect best practices. Overall, the number of chest X-rays ordered for asthma patients has declined 35 percent.

After the early success in the asthma initiative, Texas Children's began using the investigative approach for other care areas common to its patient population, including appendectomy, spine surgery, pneumonia, diabetic ketoacidosis and others.

Improvements in care delivery also have been achieved with appendectomies, the most common indication for abdominal surgery in children, accounting for a third of all childhood admissions for abdominal pain. Improvements resulting from cross-functional group analysis include 93 percent standardization on a mono-therapy antibiotic for appendectomy; 85 percent usage of order sets for care process team activities; and decreased complications and lengths of stay.

Savings, Improvements and Areas for Further Development

Benefits from the approach are also showing up as savings, across both clinical and administrative areas, resulting from care improvements and lower costs.

Texas Children's executives estimate they have achieved about $4.5 million of direct benefits from only four of its EDW projects. Davis said the organization is benefitting as the warehouse is able to make use of meaningful data that previously had been "trapped" in the EHR.

These early successes in the hospital-based program have Texas Children's thinking about expanding its focus. It is taking steps to expand the initiative beyond hospital-based care to include its primary pediatric practices and clinic-based care.

In addition, the organization hopes to use executive dashboards to take advantage of the EDW's ability to pull together information from organizational information systems that had operated separately, such as the enterprise resource planning (ERP) system and other business systems. The ability to get snapshots of this information in near real-time is expected to help guide executive decision-making, Davis said. Dashboards currently in use include labor and productivity, length of stay and other operational areas; more are under development, Davis said.

For example, the labor and productivity tool helps managers optimize the number of worked and paid hours in relation to the units of service produced in their departments. The EDW combines data from the EHR, time clock, ERP and budgeting source systems to make it easier to measure productivity against internal and external benchmarks. It helps analyze staffing levels and staffing ratios, helping managers bring labor expenditures in line with actual patient volumes.

Even with the capabilities of the EDW, Texas Children's expects continuing challenges in further using EHR-based information for process and care improvement.

Although the teams bring together those knowledgeable in their subject areas, getting others in the team to "think" in new ways and absorb new areas of expertise can be challenging. It's still rare to find clinicians who quickly absorb data manipulation knowledge, or IT staff who are adept at understanding how clinicians want to delve into the data, Macias said.

While the data in the EDW is helpful, it is not perfectly suited for research – that process is ongoing, said Kathleen Carberry, who is director of Texas Children's Hospital Outcomes and Impact Service, which uses outcomes data to improve healthcare decision making.

Carberry believes the EDW will eventually obviate the need for individual databases that Texas Children's and other facilities use to track outcomes and to conduct research. However, more work needs to be done to ensure that the data entered by clinicians and others, which winds up in the EDW, is of high enough quality to provide trustworthy research findings.

"I feel like our data collection is on a continuum; about 10 percent of it is 'electronic' and 90 percent of it is manually collected," she said. "We still have to work on getting the right information in the EDW. You can assume that just because the data is in the EDW, a lot has happened in terms of data quality. However, just getting the EDW in place has been a big first step.

"The EDW is breaking down the barriers of how people work together. We're making some progress in respect to true partnering. On the provider side, it's helping clinicians communicate with people in IT. It's an iterative process, a whole different way of operating."

- Kathleen Carberry, Director of Hospital Outcomes and Impact Service

"The EDW is breaking down the barriers of how people work together," Carberry added. "We're making some progress in respect to true partnering. On the provider side, it's helping clinicians communicate with people in IT. It's an iterative process, a whole different way of operating."

Macias believes it will take time to fully change the culture and approaches through the application of local, data-based evidence, but it's crucial for clinicians to have that information – from their own patients and from their own facility – to revisit long-held beliefs and habits of providing care.

"Physicians are all about delivering the best care to patients," he said. "If you simply put the data out there, we can ask ourselves, 'Am I doing the best that I can do?' They want to find the best solutions."

"Surgeons are competitive human beings," Lopez added. "I've seen variations in practice (based on findings revealed from EDW outcomes). Everyone is into being part of the solution. We had no problem getting physicians engaged with this."

Texas Children's Hospital, a not-for-profit organization, is committed to creating a community of healthy children through excellence in patient care, education and research. Consistently ranked among the top children's hospitals in the nation, Texas Children's has recognized Centers of Excellence in multiple pediatric subspecialties including the Cancer and Heart Centers, and operates the largest primary pediatric care network in the country.

Achieving Improved Care and Savings

Implementing the clinical data warehouse at Texas Children's Hospital offered unique challenges, with various participants providing assistance at each step, and several problems required solutions at each stage of the project.

For example, team players varied during the initial implementation, and leadership and project sponsors were involved in all phases of the project.

Generally, there's nothing on the technology side that is ground-breaking, says Mark Rittenhouse, business intelligence architect at Texas Children's Hospital. "How the technology is used presents the biggest 'challenge,' though even those were not particularly daunting and had not been solved by others already.

"We would do a bit of research of possible solutions and decide what we wanted to do," Rittenhouse added. "Internet searching is invaluable and saved countless hours of time. From security strategies to SQL query challenges, most were solved by documentation available on the internet. While not specifically a 'required' technology, we'd be remiss to not mention that the Internet played a huge role in resolving issues."

Before the project: Initial hardware/software implementation
Timeframe: once contracts were signed, about 1 month

Team Players
The vendor supplied a detailed list of software that was needed before Texas Children's could start the EDW implementation.

"We worked with the following groups to get our development and production systems in place so that we could start," Rittenhouse said.

- Enterprise system support to install and configure the servers, OS and SANs.
- Purchasing to help ensure all licensing was in place for SQL Server Enterprise and Developer tools.
- Database administrators to configure databases and set up access accounts to source systems.
- Network/system security to help setup to allow multiple users on the development server.

Technology Required
- 2 servers – development and production
- SAN storage
- Development software
    1. Microsoft SQL Server Enterprise (2 instances for the development and production servers)
    2. Microsoft BIDS (SQL Server Management Studio/Integration Services/Reporting Services etc.)
    3. Microsoft Office (Word/Excel)
- Idera – SQL Diagnostic Manager – mostly for auditing SQL statements
- Oracle SQL Developer (for Oracle source system DB access)

Technology Challenges
Generally there were no technical challenges in this phase, but there were some practice differences.
    1. Allowing non-administrator login access to servers was not typical here. "We wanted to utilize the processing power of the development server for SSIS/ETL development," Rittenhouse said.
    2. Evolved ETL checklists until they were tuned for Texas Children's, "but many of the details we had to initially do manually have since been automated," he added.

EDW Implementation Phase 1: Building "The Core"
Timeframe: about 3 months

Team Players

The Texas Children's implementation started with two data architects working daily with the vendor. "This was an intense three months to get the 'core' of the EDW in place," Rittenhouse said. "The plan was to get core tables in place, then start driving value out of the system as quickly as possible. Most of this was 'heads down' SSIS-ETL work."

- The vendor's technical resource staff trained data architects on the backend technology (SSIS and Metadata), and how to add data to the EDW.
- The data architects "learned to fish" on all support and enhancement aspects of the EDW technology.
- Web application support services for intranet data dictionary and data entry applications, which required 10 to 20 hours of work.
- Web support services for SharePoint and reporting site assistance, which also required about 10 to 20 hours of work.

Technology Required

- The organization started implementing SharePoint Reporting sites to start the learning curve on how to bring the data to customers in later phases.
- It used Microsoft IIS for delivered intranet applications.
- It utilized its existing Active Directory infrastructure.

Technology Challenges

- The organization developed how it wanted to manage security of the data and user access at this phase.
- One of the bigger challenges is dissecting the source systems to determine what data are needed, and where specific information is stored, Rittenhouse said.
- "We had been working with SSIS for about a year prior to this engagement, so the learning curve on SSIS and the EDW ETL architecture went very fast," he added. "Every attempt to be practical about the implementation was made, and this really helped keep training simple, and maintenance straightforward and consistent."
- The organization thought at length about how to deliver the data to users in a simple-to-use software that would meet dynamic data requests, as opposed to static reports with a few levels of drill down, which seemed "like a slower than desired implementation path," he said.

EDW Implementation Phase 2: Driving Value
Timeframe: from first information coming from system in about 1 month – to the present

Team Players

This phase started with Texas Children's clinical programs to focus on care process and ETL for additional source systems.

"We started training three additional data architects to assist bringing in PeopleSoft data, and for the anticipated business demand," Rittenhouse said.

The care process teams began working in this phase. "There are larger teams with several members from the customer base who provide guidance and decisions on which aims to address," he said. "Smaller work teams were formed to complete the detail work."

The small teams consist of members from the following areas:
 - Physicians/clinical experts
 - Quality and outcomes – team leads and statisticians (separate people/roles, but from the same department at Texas Children's)
 - Evidence-based medicine - clinical evidence support
 - Nursing/clinical experts
 - IS - data architect

Technology Required
  - Added QlikView as the visualization software.
  - An additional server was added to handle the QlikView application reload and distribution processing as well as serving up the QlikView applications to the Intranet. The Dev QlikView services was set up on an existing development server.

Technology Challenges
  - Integration of QlikView applications access and auditing into security and auditing structures.
  - Orienting customers to the Agile Development method. Incremental builds instead of Big Bang approach.
  - Upon discovering data issues, the organization came to understand that the input process is where to fix the data.