Modernizing healthcare technology for today's needs and tomorrow's possibilities

HIMSS Analytics research sheds light on the state of the journey toward cognitive healthcare

When patients develop a sore throat and congestion, their physician typically will attempt to determine if a cold virus or bacterial infection is the culprit. Oftentimes, just to be safe, the physician will write a potentially unnecessary prescription for an antibiotic in hopes of eradicating the infection.

Patrick Chain, genomics researcher at Los Alamos National Laboratory, posed: But what if a nurse could swipe the patient's saliva and run a quick genetic test for bacteria? If the test results are positive, the patient gets the antibiotics. If the results are negative, the patient is prescribed decongestants and plenty of rest. The use of this genomic information would take the guesswork out of the process – and help to curb the use of unnecessary antibiotics.[1]

The case for genomics stretches far beyond the treatment of irritating sinus infections, though. For example, liquid biopsies, which test for cancer via a simple blood draw – removing the need for invasive surgeries – can have a positive impact on the early diagnosis and effective treatment of various life-threatening forms of cancer. In fact, in addition to colds and cancer, genomics can help to improve treatment for a wide range of diseases from irritable bowel syndrome to Alzheimer's to Crohn's disease and more.[1]

The potential is plentiful, but there's a pitfall. Genomics requires the ability to access, manage and analyze significant amounts of data. And, that's a significant undertaking, as just one file of genomic code is quite large.

Indeed, a whole genome sequence requires the same amount of data storage as 100 feature-length movies or 150 gigabytes of data storage, according to a research report from the Workgroup for Electronic Data Exchange (WEDI).[2]

Therein lies the unfortunate – yet increasingly common – big data rub. While the proliferation of data holds unprecedented potential for healthcare organizations, the need to effectively manage data is emerging as a considerable, if not overwhelming, challenge.

Indeed, healthcare organizations are now grappling with the growing mandate for change by trying to leverage the data that can address affordability, accessibility and quality challenges commonly associated with delivering care in a value-based environment. The problem is that most organizations lack the modernized healthcare technology, data management disciplines or skilled resources to benefit

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from the influx of data. To address this challenge, providers must develop a strategy that will enable them to move beyond the current status quo and implement next-generation healthcare information technology (IT). By doing so, healthcare organizations can reach beyond mere data collection to dynamically manage, store, analyze, archive and share data in the most time-efficient and cost-effective manner. They will also position themselves to leverage rapidly emerging machine-learning technologies that can analyze massive volumes of data and interact in natural language to augment human expertise, accelerate discovery and support informed decision-making. In sum, with modern healthcare IT in place, healthcare organizations will be able to effectively manage the tsunami of data in the current environment while also building a bridge that can help them to eventually adopt more advanced cognitive computing models.

By creating this environment, the healthcare industry could finally experience the change that it is looking for. Indeed, 80 percent of the 125 healthcare executives who participated in the *HIMSS Analytics Cognitive Healthcare Study* indicated that cognitive healthcare could be the transformative force that is so sorely needed (Figure 1).

Figure 1. **Over half of respondents agree that cognitive healthcare is transformative, relevant to their organization and essential to organizational success.**

Drawing on results of the study as well as insights from industry thought leaders, this white paper takes a broad look at where the industry stands on this journey toward implementing the modern healthcare technology that can expertly handle today's data challenges, while also positioning healthcare organizations to experience transformation and enablement through cognitive computing capabilities.

"The healthcare industry is exploding with new information, and as we continue to move towards advanced clinical analytics, we know this trend is not slowing down."

Bryan Fiekers | Senior Director, Research | HIMSS Analytics

"The healthcare industry is exploding with new information, and as we continue to move towards advanced clinical analytics, we know this trend is not slowing down. New leaders are in place to manage this data and they are anxious to fully leverage it," said Bryan Fiekers, Senior Director of Research at HIMSS Analytics. "This research illuminates why it is so important to have the proper infrastructure in place to satisfy not only the needs of today, but also the needs of tomorrow."

Describing the data deluge

The rapid adoption of biomedical advances, artificial intelligence, connected devices, digital pathology, population health, genomics, connected health and other technologies is contributing to an unprecedented explosion in healthcare data. "Healthcare organizations are now dealing with massive amounts of data from medical records, and also from a wide variety of medical instruments and devices, including wearable sensors," said Jane Yu, MD, PhD, Biomedical Engineering, International Client Technical Engagement Leader for IBM Watson Health.

Certainly, a variety of studies corroborate with this observation. Consider the following:

- Healthcare data is experiencing a 48 percent annual growth rate that will lead to 2.314 exabytes of data by 2020, according to research and analysis from IDC.[3]
- The amount of healthcare data is expected to grow from 500 petabytes in 2012 to 25,000 petabytes in 2020, according to Orion Health.[4]

- If all digital data in healthcare were loaded onto the memory in a stack of tablets, it would reach 82,000 miles high, one third of the way to the moon by 2020 – up from just 5,500 miles high, three percent of the way to the moon in 2013, according to IDC.[5]

- Genomic data is expected to become an increasingly integral part of the healthcare equation. In fact, according to survey results published in the NEJM Catalyst in March of 2017, 40 percent of respondents said genomic data will become one of the most useful data sources in five years, up from just 17 percent today.[6]

- The use of computed tomography has grown from less than 3 million per year in 1980 to more than 80 million annually in 2015, according to Consumer Reports.[7]

- Between electronic medical records (EMRs), digitized diagnostics and wearable medical devices, the average person will leave a trail of more than 1 million gigabytes of health-related data in their lifetime, according to IBM estimates.[8]

"Data is on everyone's mind. It is flowing out of every instrument – faster and bigger each day."

Frank Lee | PhD, Molecular Genetics | Global Leader, High-Performance Data Analytics, Healthcare Industry | IBM

All of this data is a welcome development for healthcare organizations. According to the leaders who participated in the *HIMSS Analytics Cognitive Healthcare Study*, provider organizations are embarking upon a variety of initiatives that require them to rely on data to meet their goals. In fact, survey respondents pointed to population health, value-based care and healthcare consumerization as the top three priorities in 2017.

Each of these initiatives hinges on data use. Consider the following: To manage populations, healthcare organizations need to integrate clinical, claims and socio-economic data to identify and serve at-risk populations. To succeed under value-based care, healthcare organizations need to report process and performance measures to regulatory bodies and to rely on analytics programs to monitor clinical and financial outcomes associated with specific populations. In addition, to support consumerism, healthcare organizations are seeking to leverage complex data sets that include information culled from wearable devices, images and social media.

The mere existence of data, however, is not enough. Instead, healthcare organizations need to leverage the modern healthcare technology that will enable them to transform this proliferation of unwieldly information into actionable information today and to eventually move toward the transformation that could come with cognitive computing models that offer the insight needed to make more informed decisions. In fact, with next-generation technology in place, healthcare organizations could address a variety of pressing industry issues such as:

- The gap in the accuracy of treatment decisions. As many as 44 percent of all initial cancer treatments are modified on the second course of treatment.[9]

- The ability to keep pace with evidence. Less than 50 percent of medicine is evidence based. An epidemiologist would have to read 167 hours a week to keep up with new professional insights.[10]

- The need to keep up with an aging population. For example, 25 percent of Japan's population is over 65, growing to 40 percent by 2060.[11]

While data could help healthcare organizations address these and other challenges, the problem is that much of the emerging data typically exists outside of commonly used medical information technology systems and, therefore, largely goes untapped. In fact, most organizations lack the IT infrastructure, data management capabilities or skilled resources to truly leverage data in a transformative manner. In order to remain financially viable and relevant in their market, providers must develop a strategy for bridging from their current infrastructure and operations toward the next generation of healthcare IT.

Dissecting the data management challenge

With data volumes "doubling every six months," it's difficult for healthcare organizations to manage the constantly growing influx of information, according to Yu. "Healthcare organizations have to know how to access, store, share and analyze this data. And, that's a challenging proposition because of the size, variety and unstructured nature of all this data," she said. In fact, Frank Lee, PhD, Molecular Genetics, IBM Global Leader of High-performance Data Analytics for the healthcare industry, pointed out that data

has become a "four-letter word. It is on everyone's mind. It is flowing out of every instrument – faster and bigger each day."

Not surprisingly, then, analyzing data across the continuum is emerging as an especially vexing challenge. For example, a healthcare organization might want to do a population study to try to understand the relationship between genomic information and information in a clinical record and information in a medical image. "So, there are all these different data types that you want to analyze, but all those data tend to be captured in data silos," Yu said.

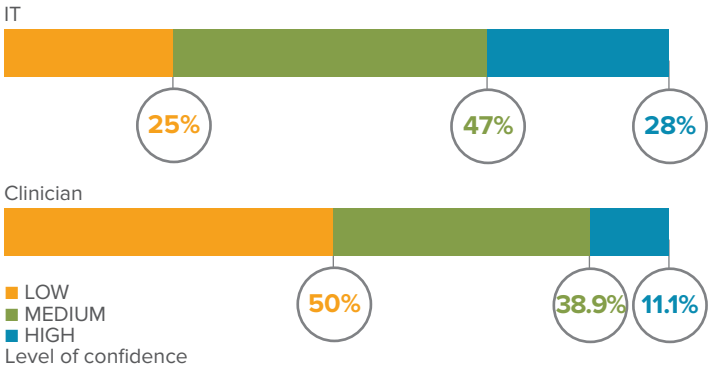
"It's really all about reducing unit cost while simultaneously increasing agility and dropping time to insight."

Art Beller | Vice President | WW Technical Sales | IBM Systems

The frustration is one that haunts many healthcare organizations. In fact, only half of clinicians who participated in the HIMSS Analytics study reported that their current IT infrastructure supports a single integrated view of enterprise data while 75 percent of IT professionals indicated that they had a "medium" or "high" level of confidence in the ability of their IT systems to provide this single integrated data view (Figure 2).

The problem is that many healthcare organizations rely on standalone systems. "There's a [data storage] appliance for

Figure 2. **Clinicians feel the inability to have a single integrated view of enterprise data is a major weakness at their organizations.**



imaging. There's one for lab. There's one for genomics and so on. With all of these standalone systems, the data resides in silos and is difficult to leverage," said Art Beller, Vice President, WW Technical Sales, IBM Systems. This lack of data integration makes it virtually impossible to collaborate. "We were working with healthcare provider organizations where researchers were saying 'my number one limiting factor is I've got to stop what I am doing to go get another set of data. To do so, I need IT help,'" he said.

Case in point: A director of information services at a West Coast healthcare system pointed to "interoperability and knowledge sharing" as one of the most vexing technology challenges. "Any infrastructure capability that allows for plug and play that will pull data from multiple environments into a single structured model, is a critical factor for us today. If I had a magic wand . . . I'd be able to take an EMR, plug it in and it [would have these capabilities]," he said.

Deciding to make the next-generation investment

With these challenges front and center, healthcare leaders are recognizing the need to rapidly invest in modern healthcare technology that can help them better manage data, integrate information into a single view, empower clinicians to collaborate – and stand ready to take on more advanced initiatives such as cognitive computing in the future.

Indeed, they are recognizing the need to move to cloud computing and software-defined architectures that offer secure, flexible, highly scalable compute and storage resources that far exceed their current legacy on-premise platforms (Chart 1).

"We are preparing for the shift from volume to value, population health management, patient engagement and precision medicine," said a CIO from an East Coast health system who participated in the study. To do this, the CIO said his health system is looking to "prepare its infrastructure to do more analytics and population health management, especially in the cloud environment, and then shift a lot of workloads and applications to private hybrid cloud-hosted environments."

According to the survey, 75 percent of healthcare organizations that identified as currently having a low level of a single integrated view of data indicated that they are

Chart 1. Common attributes of a next-generation healthcare IT infrastructure.

- ✔ Scalable and low-cost, high-performance compute and storage solutions
- ✔ Flexible architecture to support rapidly changing analytics application requirements
- ✔ Seamless integration of data on a common analytical platform
- ✔ Rapid extraction and analysis of unstructured data
- ✔ Metadata collection for repeatability and auditability
- ✔ Tools for collaboration across geographic boundaries
- ✔ Data privacy and security for Protected Health Information and intellectual property
- ✔ Easy and cost-effective IT administration

looking to invest in modernizing their data architecture. Larger and smaller organizations alike also indicated that they were looking to invest, with 59 percent of providers with greater than 500 beds and 58 percent of hospitals with 250 to 500 beds looking to invest.

The motivations behind these investments most often came down to a need to improve data access, conduct analysis and utilization (88 percent), improve internal business process efficiency (82 percent) and reduce costs and/or liabilities (69 percent) (Figure 3).

"The infrastructure needs to be scalable. As the data grows, organizations need to easily increase storage capacity, with minimum disruption."

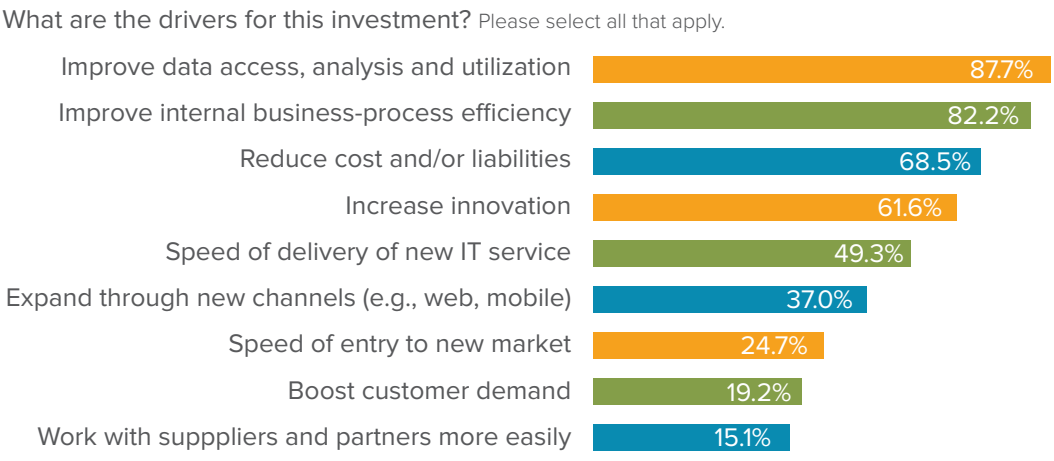
Jane Yu | MD, PhD, Biomedical Engineering | International Client Technical Engagement Leader | IBM Watson Health

"It's really all about reducing unit cost while simultaneously increasing agility and dropping time to insight. If you look at payers, providers and biotech organizations, that is really what it comes down to," Beller pointed out. "These organizations are trying to invest in innovative projects, they're trying to get FDA submissions through faster, they are trying to provide better clinical care. At the same time, though, they are trying to reduce costs. The infrastructure has to support all of these goals."

Not surprisingly, then, survey respondents most often cited data management as the top area for investment (32 percent). "The infrastructure needs to be scalable. As the data grows, organizations need to easily increase storage capacity, with minimum disruption," Yu said. "You don't want to bring the whole system down in order to add a new storage server. It has to be able to accommodate the volumes of data and also has to be flexible enough to manage all of the different data types."

Other considerations such as abating cybersecurity and ransomware threats (18 percent); enhancing application

Figure 3. **Improvements to data access, increasing efficiency in internal business processes and reducing cost or liabilities are the top drivers for investment.**

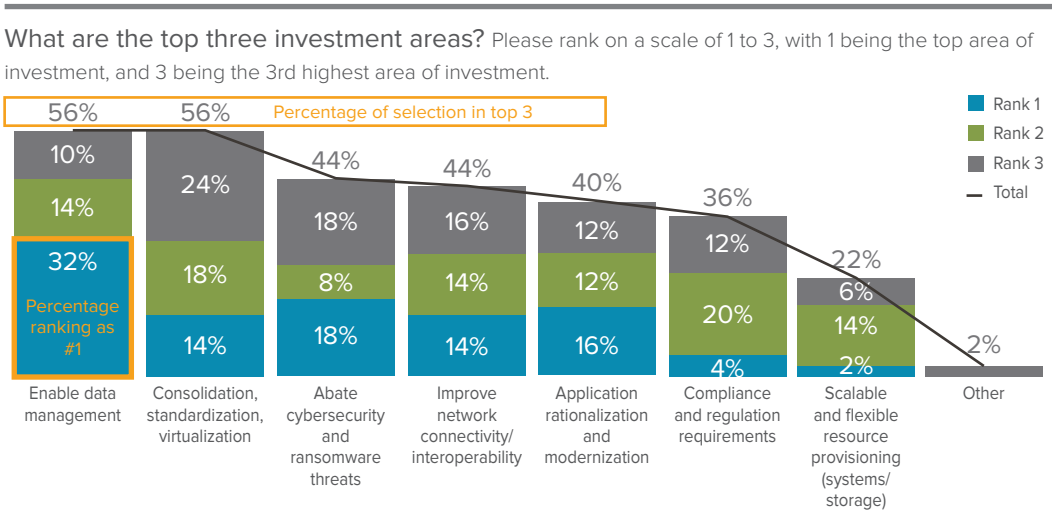


rationalization and modernization (16 percent); addressing consolidation, standardization and virtualization (14 percent); and improving network connectivity/interoperability (14 percent) were also selected as top investment concerns (Figure 4).

While these factors are prompting organizations to invest, respondents mentioned that financial pressures (88.9 percent) and competing priorities (66.7 percent) most often emerged as deterring factors on the journey toward adopting modern healthcare technology.

Once organizations decide to move forward with an IT infrastructure investment, however, data security concerns trump all other considerations. Indeed, 67.2 percent of respondents cited data privacy and security as the highest IT infrastructure priority, followed by analytics (60 percent) and data management (57.6 percent).

Figure 4. **Enabling data management is the clear top area of investment, but other areas of investment are dependent on organizational need.**



"Organizations are working with research collaborators all over the world, and they need to share data and they need to do it in a way that's efficient and secure. So security becomes a huge issue," Yu said.

As such, data federation has become a coveted component of IT infrastructures. With this approach, data stays in one place, easily accessible to users. Simply put, because the data doesn't move, it remains more secure.

Discovering the myriad possibilities

Once organizations get this more sophisticated technology in place, they are apt to discover a bounty of new possibilities. Indeed, with a more modern IT infrastructure, healthcare organizations can:

Support personalized medicine. "In the future, hospitals will be going down a clinical genomics path and implementing personalized medicine. To figure out what the specific pathology is for each patient's ailment, each patient's genome, organizations will need to find a way to integrate all the phenotypic data with the genotypic data – and without a system to do that, it's a nightmare," Beller said.

Leverage myriad data to empower the delivery of care under new models. As healthcare organizations move toward value-based models and population health, they need to draw upon new sources of data to enhance the ability of care teams to understand and alleviate social care barriers their patients face. More specifically, they need to zero in on the "social determinants of health" (SDH), according to Karen Handmaker, global leader of population health strategy at IBM Watson Health. As such, healthcare organizations need to collect and analyze data elements such as socio-economic status, race, ethnicity, family structure, access to care,

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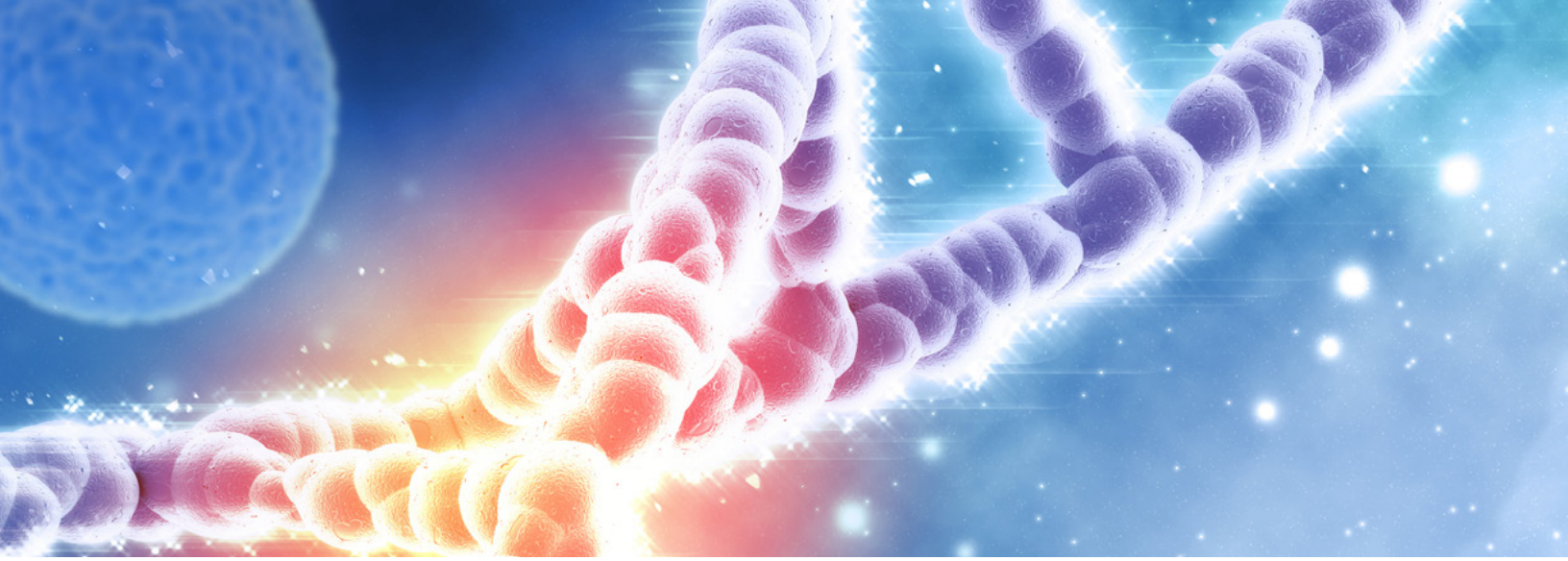
Frank Lee, IBM



transportation options, diet and education as they evaluate both personal and population health. “As the healthcare industry moves toward value-based care, and more hospitals and clinicians assume financial risk for their services, they’re realizing that addressing certain aspects of SDH can help mitigate challenges that impede the ability of individuals to manage their health, and, by extension, improve population health outcomes,” she wrote in a recent blog post.[12]

Collaborate across the enterprise. Healthcare is becoming increasingly reliant on working across organizations. Consider the following example: A scientific researcher is apt to need secure, rapid access to massive biomedical data sets held at a remote research and development site. With a traditional IT infrastructure, data access is limited by high-latency network connections and limited local storage. A next-generation IT infrastructure, however, employs distributed disk caching technology to improve the productivity of globally distributed projects by speeding up data access among collaborators.

Reduce costs via shared storage infrastructure. For example, business analysts and biomedical research scientists from different user groups are implementing costly data silos to store rapidly growing volumes of big data. A next-generation IT infrastructure can accommodate workloads, scale storage and store at low costs.

Experience faster, more accurate, more contextual and relevant diagnoses. “So now when you are looking at a patient from a tumor perspective, pathology perspective, you can actually look at the composition of the tumor cells in great detail,” Lee explained. In the past, only single tumor cells could be viewed. “Now, you can molecularly separate the tumor into different clones, even down to a single cell to look at the genetic composition of the tumor. By doing so, you can detect disease earlier by picking up signals including cancer DNA, and you can also monitor the treatment of the disease,” he said.

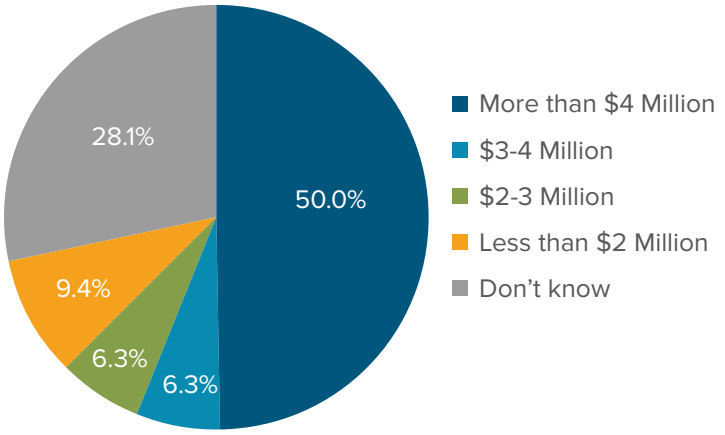
All of this, however, is very data driven – based on very precise data and large quantities of data. “It is just opening up so many possibilities,” Lee noted. “Think about it: 15 years ago, it took 10 years and 2.7 billion dollars to sequence the first genome. Now we can do that with less than 10 thousand dollars in a week.”

Although these possibilities are alluring, the need to move to a next-generation IT infrastructure often is predicated on more practical matters.

Beller pointed out that not many hospitals feel pressured to build the clinical genomics infrastructure of the future right now. “I think what they are doing, though, is figuring out what is the best way for me to pull off data integration while reducing my unit cost,” he explained. “So while we would like to talk about the intergalactic things that can be accomplished, hospitals and other healthcare organizations are dealing with data integration and ease of information flow at lower unit costs. That’s what it comes down to.”

Survey respondents expect that investments in IT infrastructures will quickly pay off. In fact, 50 percent of respondents expect, at least, to make their money back from their investment (Figure 5).

Figure 5. **Respondents investing $4 million or more expect an ROI of more than $4 million.**
What do you expect your annual Return on Investment (ROI) will be? (Respondents who indicated investing more than $4 million)



The move to a more modernized healthcare technology can enable organizations to move beyond surviving in a world of value-based care, where organizations are being called upon to cost-effectively treat patients. The move is also preparing for a future where organizations will rely upon data to create the cognitive healthcare system that will truly move biomedical research and clinical care to a whole new sphere.

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