

# 7 WAYS TO MANAGE RAPID PATIENT DATA GROWTH

How Healthcare Organizations Can Drive Storage Efficiency, Scale on Demand without Limits and Ensure High Availability and Protection.

## EXECUTIVE OVERVIEW

The clinical data caregivers rely on for patient diagnosis and treatment is growing more rapidly than ever. However, many hospitals, clinics and other healthcare facilities lack the IT infrastructure to support it.

The push from Washington to make electronic medical records (EMRs) a mainstay of the U.S. healthcare system is a major factor behind the patient data growth. The Health Information Technology for Economic and Clinical Health Act (HITECH) stipulates that all patient records – including historical data – need to be in electronic format by 2014. Meeting that deadline will be difficult for many organizations. The \$17 billion in stimulus funding will help, now that the government has defined “meaningful use” and will reimburse technology upgrades accordingly. But it won’t solve the underlying problem – that many data centers in healthcare facilities are running out of the physical space to house all that data, never mind consuming mass quantities of energy for power and cooling.

Increased use of medical imaging studies is also a major driving force. Long the standard image management technology for radiology and cardiology departments, Picture Archiving and Communication Systems (PACS) are now commonly used by oncologists and other specialists. The images generated can average 150MB each, with hundreds of images per study. And the number of studies conducted is doubling each year, while the size of each image increases as the technology becomes more advanced.

To address the rapid and unexpected data growth driven by EMR and PACS initiatives, healthcare organizations need an ultra-efficient, easy-to-manage storage solution that fully utilizes system resources, intelligently manages and migrates data, and scales on demand without limits. Only then can healthcare IT administrators minimize the data center footprint and contain overall storage costs. Meanwhile, healthcare organizations need to meet stringent patient data availability, retention and protection requirements as outlined in the Health Insurance Portability and Accountability Act (HIPAA).

This white paper discusses seven ways healthcare IT teams can use Compellent Fluid Data storage to drive efficiency, ensure high availability and protection, and readily adapt to constant change.

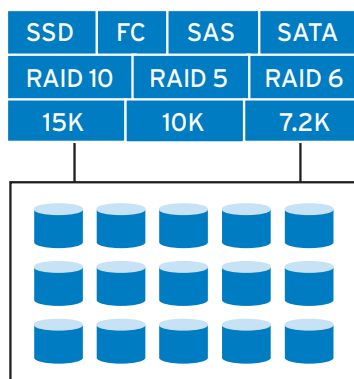
- 1. Virtualize the Storage Infrastructure**
- 2. Leverage a Persistent Hardware Architecture**
- 3. Consume Capacity Only As Data Is Written**
- 4. Migrate Data Automatically Based on Actual Use**
- 5. Protect Data in Real Time with Near-Instant Recovery**
- 6. Consolidate File- and Block-Based Data**
- 7. Centralize and Automate Storage Management**

## 1. Virtualize the Storage Infrastructure

Driving storage efficiency in healthcare begins with managing data at a more granular level – and virtualizing the storage infrastructure. Most storage systems, especially the legacy systems still found in many hospitals, generally manage data as complete volumes on specific drives. Therefore, the disk space on which a volume resides is dedicated to particular server or application. This conventional approach wastes disk space and limits system performance from the outset. In most cases, only a fraction of the capacity set aside for each application will ever be utilized, especially not upfront. And some applications such as EMRs and PACS are more demanding than others, creating I/O bottlenecks by sending read/write requests to the same set of drives. Meanwhile, spindles with only sporadic activity spin continuously, squandering energy on constant power and cooling.

To reduce capital and operating expenditures while boosting efficiency and performance, healthcare organizations need to manage data within the volume itself. With Compellent, a dynamic Fluid Data architecture enables block-level data management. Information about each block provides real-time system intelligence, allowing the system to dynamically store, migrate and protect data throughout its lifecycle – often using built-in automation for zero-touch management. This granularity and system awareness also allows Compellent to virtualize storage at the disk level, providing high efficiency, performance and flexibility from the bottom up. Healthcare IT administrators no longer need to pre-allocate capacity on specific drives to particular servers. Instead, an advanced virtualization engine abstracts all physical components within the system – from drives to controller processors – creating a pool of shared resources continuously available to all servers. Combined with virtualized servers, storage virtualization brings unparalleled efficiency, flexibility and resiliency to the management of patient data.

**Figure 1:** *Storage Virtualization abstracts storage at the disk level, creating a shared pool of resources available to all servers.*



With Compellent, storage is presented to servers simply as capacity, regardless of disk type, storage tier, RAID level or server connectivity. In fact, administrators can provision any size volume in seconds without actually setting aside physical space. That means even previously allocated capacity without any writes is still available to other applications. And since the volumes are virtual, they span multiple drives, increasing efficiency and performance. Administrators can add capacity, expand volumes and make changes on demand with downtime or disruption, and data is automatically restriped across all drives for hands-free load balancing and performance tuning. Read/write operations are also spread across all drives, allowing multiple I/O requests to be processed simultaneously. This eliminates the bottlenecks that can occur when clinical systems are taxed during acute or emergency care. In short, physicians, nurses and medical technicians always have access to the diagnostic and treatment information needed to make critical decisions about patient care.

“By moving to a shared pool of storage, we could improve utilization as well as flexibility to accommodate growth.”

MATT WINN  
Director of IT, First Medical Management

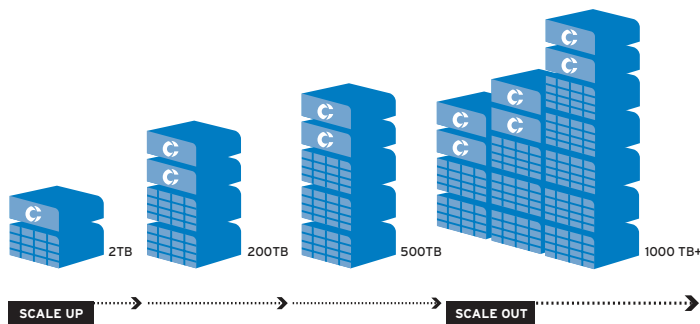
## 2. Leverage a Persistent Hardware Architecture

Healthcare organizations continue to contend with rigid, inefficient storage systems with dead-end growth paths. Designed for early obsolescence, these proprietary solutions cannot be easily expanded or upgraded. To adopt the latest technologies and respond to rapid data growth, administrators are forced to rip and replace existing hardware, buy new software licenses and migrate data to a different platform. In most cases, it is only a matter of time before the entire storage infrastructure needs to be overhauled, simply because the system vendor imposed arbitrary restrictions on that particular model. Such limitations present a major hurdle for healthcare organizations, as there is no way for IT teams to accurately assess future storage needs resulting from rapid patient data growth.

Compellent Fluid Data storage is engineered for persistence, not obsolescence, eliminating the need for forklift upgrades and protecting IT investments well into the future. Healthcare organizations can scale without limits on a single, modular

hardware platform. Administrators can start with any size system and expand on demand – from 2TB to more than 1,000TB – without having to replace existing infrastructure or networking components. They can also mix and match SSD, FC, SAS and SATA drives, as well as iSCSI and FC interconnects, in the same system. This technology independence enables IT teams to strike a balance between cost and performance. They can utilize any combination of industry-standard technology and add capacity or augment system configuration on the fly – all without disrupting caregiver access to patient data, much less taking clinical systems offline. Also, incorporating the latest technology as it becomes available – from drives and enclosures to controllers and I/O cards – is as simple as plugging in new components.

**Figure 2:** Healthcare organizations can scale without limits on a single, highly modular storage platform.



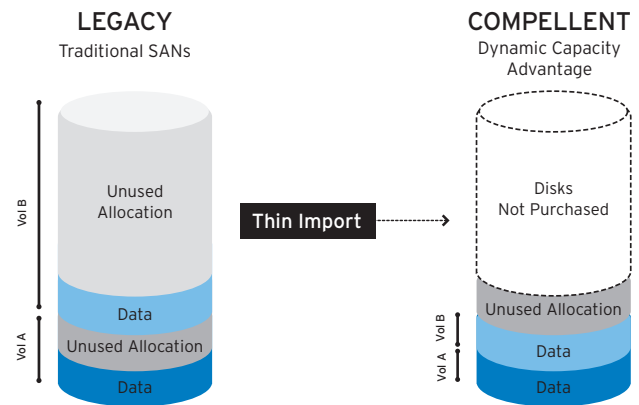
Fully redundant hardware and advanced failover features ensure high availability 24/7. Controllers feature active dual paths, mirrored cache, multi-port interconnects and redundant power supplies and cooling fans. In a clustered configuration, the controllers operate in unison to enhance availability yet connect independently to ensure no single point of failure. Virtual ports further increase availability while increasing port capacity and failover, disk bandwidth and I/O connectivity.

### 3. Consume Capacity Only As Data Is Written

For most healthcare facilities, physical space is at a premium, with as much space as possible reserved for patient care. In addition, many facilities – hospitals, in particular – are located in older buildings that weren’t designed to house large data centers. This makes driving IT efficiency not only a matter of aligning cost with budget, but accommodating rapid data growth within a limited footprint. Therefore, it is more important than ever that healthcare IT teams optimize storage resource utilization, especially in terms of disk capacity.

The storage systems used at many healthcare facilities underutilize disk capacity in a number of ways. For one, physical disk space is pre-allocated whenever storage volumes are created. An application may only require 500MB of space at the time storage is provisioned. However, over time the application may need several terabytes or even petabytes of storage, whether it is an EMR, PACS or coding and billing system. Therefore, the healthcare IT administrator estimates future needs and allocates “extra” space based on business projections. Accommodating growth later by migrating data to a new volume is possible. But it is a tedious, time-consuming process that requires taking the application offline – and possibly compromising caregiver access to patient data. Also, since capacity later abandoned can’t be reclaimed, that space needs to be replaced or left stranded and drawing power. In fact, even space pre-allocated for a given application – but never written to – cannot be used by any other application, as zeros are written to reserve that capacity. Before long, a healthcare organization’s data center footprint and electric bill can grow out of control simply because of stranded storage.

**Figure 3:** Thin Provisioning separates storage allocation from utilization, eliminating pre-allocated but unused capacity.



Compellent Thin Provisioning completely separates storage allocation from utilization, eliminating pre-allocated but unused capacity. While healthcare administrators can provision any size virtual volume upfront, physical capacity is only consumed when data is actually written. No zeros are written during volume creation. Instead, Thin Write technology assesses the incoming payload on write and designates physical capacity on the fly. Meanwhile, any unused space remains available to all servers sharing the storage pool. In most cases, healthcare organizations

can regain 40 to 60 percent of capacity that would have been stranded due to pre-allocation – a surefire way to offset rapid data growth from EMRs and PACS. Healthcare IT administrators can also use Thin Import technology to convert legacy volumes into thin-provisioned volumes, instantly shrinking the data center footprint and reducing power and cooling costs. Furthermore, instead of replacing disks that housed subsequently deleted, archived or migrated volumes, users can utilize space reclamation tools to recover capacity in Windows and some Linux environments.

“Thin Provisioning helps us adjust quickly to changes. When an application needs more space, we can provide it immediately.”

DARRELL MARLOW  
Network Engineer, NuVasive Inc.

#### 4. Migrate Data Automatically Based on Actual Use

Possibly the most critical aspect of storage for healthcare organizations is the ability to dynamically move data between tiers, especially when it comes to EMR and PACS data. Storing clinical data on high-performance drives during diagnosis and treatment makes sense, as it ensures immediate caregiver access to patient information. However, retaining that data on Tier 1 after the patient has been treated is cost prohibitive and wastes data center space, particularly when the case required PACS studies.

This simple truth has led healthcare IT administrators to implement various forms of information lifecycle management (ILM), a complicated and time consuming process requiring constant attention and manual modification. With conventional ILM, patient data is continually classified and reclassified according to organizational procedures. Also, each volume must be moved by hand and in its entirety, although some of that data, such as prescription information, may be accessed more frequently than the rest. Such data migration often leads to unexpected downtime and lost or corrupted data, even after weeks of careful staff planning. Add-on migration engines can help but increase software costs and may require specialized skills.

Compellent Automated Tiered Storage makes manual data migration no longer necessary. Throughout the data lifecycle,

#### BETTER PATIENT CARE WITH COMPELLENT-BACKED PACS

Princeton Radiology had used digital medical records for nearly 20 years and was in the process of implementing PACS. The objective was to retain patient records for the life of the patient or beyond. “To accommodate such a massive amount of capacity, we clearly needed to replace the direct-attach disk drives we were using,” says Alan Howard, director of IT. “The new infrastructure had to provide the capacity we require today while scaling easily for future growth.” It also needed to provide caregivers ready access to patient data, with the ability to instantly share information with other facilities.

Thin Provisioning helps the IT team support EMRs and PACS without spending hours a day managing storage. “It allows us to be over-provisioned by as much as 2 to 3TB at any time. If and when we want to expand, we can allocate more disk capacity quickly without necessarily having to buy more disks.” This flexibility was key as the organization rolled out PACS to multiple offices and made it easy to accommodate 400GB of growth per month without downtime.

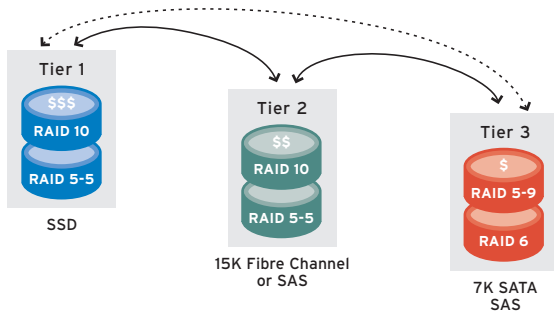
Princeton Radiology relies on a mix of FC and SATA drives to balance disk performance and cost. Since implementing Automated Tiered Storage, 85 percent of patient data has migrated to the lowest tier without manual intervention. “Automated Tiered Storage allows us to reserve the high-performance, high-cost drives for frontline care and enables us to grow cost effectively.”

In the past, the data recovery point objective at Princeton Radiology was 24 hours. “Previously we could only back up the system once per day, and we had to be sure that no one was using the system at the time.” Compellent Snapshots have enabled the organization to realize real-time data protection without interrupting access to clinical applications. “To restore from tape used to take 12 to 14 hours. Now we can recover in about five minutes.”

the system remains aware of how frequently each block of data is accessed. Leveraging this intelligence, data is dynamically classified and migrated to the optimum tier based on actual use. Healthcare IT administrators don’t need specialized skills. They simply activate the functionality, and a built-in movement engine migrates the data based on a pre-defined algorithm. Data is written to Tier 1 storage, then moves to lower-tier storage as it becomes inactive. In other words, patient records and imaging studies remain readily accessible on high-performance drives

during diagnosis and treatment. Then, after the patient has been discharged from the hospital or has completed a series of outpatient visits, that data cascades to more cost-effective, high-capacity drives.

**Figure 4:** Automated Tiered Storage dynamically migrates patient data to the optimum tier based on actual use.



This enables healthcare organizations to not only meet EMR and PACS data retention mandates with fewer drives and a smaller footprint, but keep more patient data online for longer periods of time. For example, if a patient presents with recurring symptoms a year post-treatment, clinicians can still access existing imaging studies instead of retrieving files from an offsite data archive. And if those studies become active again, the system automatically promotes all corresponding data to a higher tier. Healthcare IT administrators can add capacity, swap out networking components or augment system configuration on demand – all without disrupting access to patient data or taking clinical applications offline. With Automated Tiered Storage, healthcare organizations can cut disk expenditures by as much as 80 percent while ensuring caregivers have continuous access to patient data when and where they need it.

“Fluid Data technology automatically prioritizes our data. The system takes our PACS volume and progresses data that’s infrequently accessed to cheaper disks.”

BARRY THOMAS  
Network Administrator, Graves-Gilbert Clinic

## 5. Protect Data in Real Time with Near-Instant Recovery

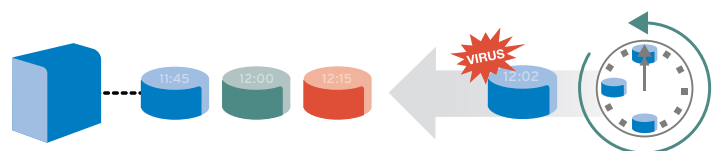
Few industries are as concerned about protecting data from server failures, power outages, natural disasters and other inevitable

circumstances as the healthcare sector. These variables can disrupt the availability of critical information required for quality patient care, as well as compromise the integrity of patient data – two fundamental aspects of continuous data protection under HIPAA. Therefore, healthcare organizations must have mechanisms in place not only to back up and replicate patient data as it is created, but quickly recover to a point in time just prior to the disruption, disaster or human error.

While many conventional storage systems provide this functionality, the way in which it is executed is highly inefficient. Traditional backup solutions are slow, unreliable and consume excess storage space. Also, restoring data to a previous state can take hours or even days. Using snapshot technology is a more effective approach. However, most snapshot solutions require full-volume clones, which not only delays recovery but limits the number of snapshots that can be taken. As such, healthcare IT administrators have fewer recovery points to work with, significantly increasing the margin for data loss. In addition, when it comes to disaster recovery (DR) planning, the cost of remote replication can be overwhelming, both in terms of bandwidth and disk expenditures.

With Compellent, once an initial snapshot is taken, only incremental changes in data need to be captured for continuous protection. Using block-level intelligence, the system remains aware of the state of each volume, ensuring that the base snapshot is always in sync with each subsequent “change in data” snapshot. Users can schedule snapshots with virtually unlimited recovery points, and Consistency Groups safeguard the integrity of clinical data spanning multiple volumes. This ultra-efficiency dramatically reduces capacity requirements and speeds recovery. In fact, IT staff can map and mount a snapshot to any server in less than 10 seconds. Snapshots can also be used to test application upgrades and updates using real datasets, deploy hundreds of virtual machines simultaneously using gold images and boot diskless servers from the Compellent SAN.

**Figure 5:** An unlimited number of snapshots can be taken of patient data for near-instant recovery to any point in time.



Eliminating the need for full-volume clones also reduces the cost and complexity of remote replication, bringing DR within reach for smaller healthcare organizations. Following initial site synchronization – which administrators can expedite using Portable Volume, a set of preconfigured external hard drives – only changes in data need to be replicated. Known as Thin Replication, this approach does not require expensive, high-speed data transfer links. Instead, administrators can use existing IP networks and take advantage of built-in FC-to-iSCSI conversion, although transferring data over FC is always an option. In addition, having identical arrays at local and remote sites is not necessary. In fact, many healthcare organizations utilize high-capacity SAS drives at DR sites to contain hardware costs and minimize footprint. Bandwidth simulation and shaping further streamline the process, allowing users to customize transfer rates based on link speed, time of day and replication priority. Also, by pre-defining the recovery sequence, administrators can recover from a disaster with a single click.

“Compellent gives us the ability to retrieve and restore lost files far more easily and efficiently than our old tape backups, which could take as much as four hours.”

GREG BRUNSON  
Database Administrator,  
Visiting Nurse Association of Southeast Michigan

## 6. Consolidate File- and Block-Based Data

With the rapid growth of EMR and PACS data, healthcare organizations need a cost-effective way to consolidate file- and block-based data. Many healthcare IT administrators continue to use direct attached storage and multiple file servers to manage PACS studies. Meanwhile, they manage EMRs and other databases on conventional SANs. This disparate management of structured and unstructured data has led to high administrative overhead, exploding storage costs and poor use of dwindling data center space.

Compellent enables healthcare organizations to consolidate multiple file servers and databases onto a single, unified storage platform, combining file-level control with block-based efficiency and functionality. All data is managed centrally in one virtualized storage pool, and files can be shared with ease across various

## FLUID DATA: THE BACKBONE FOR PATIENT INFORMATION

At Kansas Spine Hospital, more than 80 percent of patient data is generated by PACS. However, the hospital's existing storage infrastructure was costly, time consuming and difficult to scale. “With our two-person IT staff, we needed a cost-effective solution that fit our long-term growth strategy and didn't force us to hire a new administrator with specialized skills,” says CIO Michael Knocke.

With Compellent, the IT team can use a single, point-and-click interface to manage a two-tiered production SAN, a business continuity SAN at the same location and a DR SAN at a remote site. “The types of images we deal with can be quite data-intensive, but within a few seconds we can determine how much storage each application is using and whether we're nearing our thresholds.”

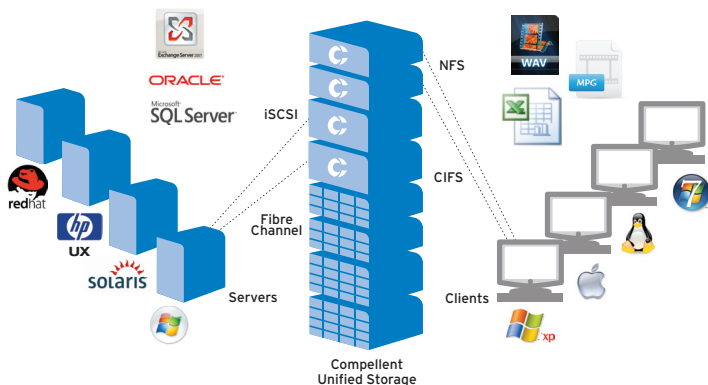
Thin Provisioning helps the organization accommodate rapid patient data growth without incurring the expense of allocated but unused storage. “I can allocate 1TB to the PACS knowing that it won't use it immediately. If that application does eventually require additional space, I can shift allocation from other applications.”

Kansas Spine also leverages Automated Tiered Storage. Previously, the organization relied on DVD media to store older patient data. Now, since inactive data dynamically moves to lower-cost disks, the administrators can cost-effectively retain more patient data online. “When a patient is in our care, we need fast access to his or her records. But once that patient is discharged and billing is complete, there is no reason to keep the data on the faster, more expensive drives.”

Continuous Snapshots and Thin Replication has allowed the hospital to bolster business continuity and implement DR at a fraction of the cost of other solutions. In fact, Kansas Spine saved at least 85 percent of the acquisition costs of a traditional backup solution. The administrators extend those savings by replicating patient data between sites over low-cost IP lines.

server platforms. The ability to share data without limit is key for quality patient care, as clinicians often need access to the same medical records and imaging studies from various locations. Also, by consolidating all data administrators can apply advanced virtualization features such Thin Provisioning and Automated Tiered Storage to not only block-based data such as EMRs, but also file-based data such as PACS studies.

**Figure 6:** Healthcare organizations can consolidate file- and block-based data onto a unified storage platform with enterprise functionality.



Compellent offers two unified storage solutions – Compellent zNAS and Storage Center with NAS. Utilizing the highly scalable Zetabyte File System (ZFS), zNAS is ideal for larger healthcare organizations with mixed UNIX, Linux and Windows CIFS/NFS environments. Storage Center with NAS, which is based on Windows Storage Server 2008, is highly effective in Windows CIFS environments. Both solutions feature a wizard-based interface for storage administration.

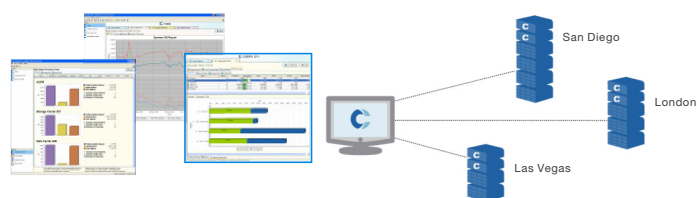
## 7. Centralize and Automate Storage Management

For many healthcare organizations, hiring IT professionals who specialize in certain areas is often cost prohibitive. Therefore, healthcare IT teams tend to have broad skill sets, with responsibility for everything from clinical application configuration and finance database administration to data security and storage management. However, most storage systems are overly complex and require healthcare IT administrators to spend unnecessary time on capacity planning, data migration, performance tuning and data protection. As a result, administrators have difficulty focusing on key projects such as deploying EMRs and may end up hiring expensive consulting firms or independent contractors just to meet critical deadlines.

With Compellent, administrators can manage all aspects of a storage system (or multiple storage systems) through a single pane of glass. An intuitive, point-and-click interface and built-in automation streamline repetitive, time-consuming tasks, and

wizards guide users through system setup and configuration. No specialized skills are required. In fact, IT staff can create volumes and map storage to servers in seconds. Scheduling snapshots, optimizing replication and augmenting tiering profiles is also accomplished using the same console. The system automatically monitors and displays all storage consumption and performance trends for analysis, alerting key personnel when capacity reaches a pre-defined threshold. Also, healthcare IT administrators can easily generate executive summaries, cost-savings calculations and utilization chargeback reports.

**Figure 7:** Healthcare IT administrators can manage and monitor multiple storage systems through a single pane of glass.



Compellent also provides comprehensive service and support through a team of technical experts dedicated to resolving any issues that may arise. Using proactive remote monitoring technology, which provides real-time system intelligence, these highly skilled storage professionals strive to identify problems before they become apparent to the customer. If problems do occur, one phone call covers the entire storage infrastructure, including any alliance partner technologies. There are no callback windows or wait times. Instead, customers always have access to a technical expert precisely when they need it. Compellent also offers a full portfolio of storage system optimization services, including design and configuration consulting in areas such as DR, to ensure healthcare IT administrators can easily address changing organizational requirements.

“The SAN has a single, easy-to-use interface that reduces provisioning times and automates frequent tasks. It has cut the time it takes to manage storage by at least 50 percent.”

DARRYN CAPES-DAVIS  
ICT Manager, Children's Medical Research Institute

## CONCLUSION

Continuing to rely on rigid legacy storage systems that underutilize system resources and squander staff time is no longer feasible for healthcare organizations. After all, managing rapid patient data growth will only become more challenging as the deadline to implement EMRs draws near and PACS studies continue to get more sophisticated.

To remain in step with ever-changing storage demands, healthcare IT teams need the ultra-efficiency, flexibility and enterprise functionality that come with a virtualized storage solution. Compellent Fluid Data storage provides a dynamic, modular storage platform that scales on demand and intelligently manages data at a more granular level, making it ideal for healthcare facilities. System resources are pooled and utilized to their full potential, eliminating the wasted disk capacity and I/O bottlenecks associated with conventional solutions. Patient data is automatically migrated throughout its lifecycle based on actual use, further increasing efficiency and reducing costs while allowing organizations to retain more data online. Patient data is also continuously protected against downtime and disaster, with near-instant recovery to virtually any point in time. And healthcare organizations can consolidate all EMR, PACS and other structured and unstructured data on a single, unified storage platform. In addition, the IT team can easily manage the entire storage environment using an intuitive, wizards-based interface with built-in automation.

With Compellent, the information physicians, nurses and medical technicians rely on to provide quality patient care is always available. At the same time, IT administrators can manage rapid patient data growth incrementally over time, making changes on the fly without downtime or disruption. No dead-end growth paths are imposed, eliminating the need for rip-and-replace upgrades. And ultra-efficiency ensures healthcare organizations can fully utilize system resources while minimizing expenses and the data center footprint.

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