



Transformation that Drives Business and IT Agility

Healthcare's Move to Cloud Computing

WHITE PAPER

Table of Contents

Executive Summary	3
Is Your Business Agile?	3
Delivery of High-Quality Healthcare Services	3
Cost Reduction	4
Risk and Reputation Management	4
Connecting Cloud Computing and Business Agility	4
Cloud Computing and Standards	5
Infrastructure for the Next Generation of Healthcare IT	6
Service Availability	7
Beyond Compute to Network and Storage Virtualization	8
Security in the Cloud	8
Cloud Computing and Point of Care	9
Hybrid Cloud Services	10
Healthcare ISV Considerations	10
Transition to the Cloud with VMware	11
VMware Professional Services	12
Team with VMware to Accelerate Innovation	12

Executive Summary

Over the last decade, server virtualization has provided healthcare organizations around the world with significant cost and efficiency benefits. Now many providers are looking to extend this proven technology foundation to enable enterprise private clouds that will improve the quality and delivery of patient care.

Several factors are driving healthcare's interest in cloud adoption. Providers must stretch their limited budgets to meet increasing product and service demands while complying with new regulations and reform legislation. Concurrently, technology-savvy caregivers and consumers now demand more and higher levels of interaction. Their needs for instant online access to personalized information, products, and services on desktop computers and mobile devices are forcing healthcare organizations to evaluate how to support new requirements with existing, complex, and difficult-to-manage IT systems.

Tired of continually modernizing legacy applications and upgrading infrastructure silos only to discover additional application and budget constraints, healthcare IT leaders are embracing the new era of IT. They are deploying cloud computing as a strategy to transform how the entire organization—not just IT—operates. And they are choosing cloud deployment models that best meet their unique challenges—approaches that provide the greatest opportunity to increase business agility.

This white paper identifies common use cases for healthcare cloud computing. It highlights the agility benefits providers can achieve with VMware® technology, and it outlines how to move your organization to the cloud with confidence.

Is Your Business Agile?

Because of rapidly changing regulations and new business demands, healthcare leaders are looking to their counterparts in IT for answers. Providers want to know how healthcare IT can help improve patient outcomes, better respond to the demands of patients and the organization, and more rapidly evolve existing IT systems into complete connected-care environments.

Yet IT organizations are already overwhelmed by the need to support new electronic medical record (EMR) systems and upgrades, “meaningful use” requirements, mergers, acquisitions, mobile technologies, bring your own device (BYOD) initiatives, and business-critical security and compliance requirements. With fewer than 30 percent of resources available to focus on innovation,¹ healthcare IT teams are looking for new strategies to improve efficiencies, particularly in newly merged healthcare entities, and to improve the way they protect personal data. Healthcare IT is embracing cloud-computing models as the ideal way to increase business agility.

Leading global management-consulting firm McKinsey & Company defines business agility as the ability of an organization to adapt rapidly and cost-efficiently to changes in its environment. For healthcare organizations, agility indicators include the active identification of products and services that improve care, significant cost reduction and revenue cycle control, and effective management of risks and reputational threats.

Delivery of High-Quality Healthcare Services

Agile healthcare organizations identify relevant products and services in a dynamic environment and then quickly bring them to market. They improve customer engagement and patient experiences while enhancing existing revenue and rapidly adapting to new policies.

Yet increasing stakeholder expectations and ever-changing healthcare regulations challenge providers' ability to deliver high-quality healthcare services. While seeking to improve patient outcomes, hospitals face uncertainty about reimbursements for the services they provide. They must pursue a way to achieve connected care even as payers struggle to offer greater transparency and life sciences firms push to increase revenue streams, shorten clinical trials, and more efficiently use research data. Moreover, providers must address how to meet the needs of a new generation of consumers—now accustomed to ubiquitous product information and engaging corporate social networking—with the best care experiences in a time of growing market and technology fragmentation.

¹ Gartner. “Top Predictions for IT Organizations and Users, 2013 and Beyond: Balancing Economics, Risk, Opportunity and Innovation.” Daryl Plummer, et al., October 19, 2012.

Cost Reduction

Agile healthcare organizations inherently reduce costs. They continually identify and capture operating improvements in organizational processes, accelerate project execution, and maintain costs as service demand grows. Agile healthcare organizations do much more with less—an imperative in the current environment.

As budgets shrink and interest in new services increases, providers across the globe are experiencing intense cost-management pressures. In the United States in particular, healthcare reform measures are expected to bring high numbers of newly insured citizens into the healthcare system. Providers must address this increase, and the requirements of an aging population, without raising costs. They must also prepare to reduce overhead because of declining government reimbursements while strategically investing in expensive and complex EMR systems to avoid stiff noncompliance penalties.

Risk and Reputation Management

Agile healthcare organizations maintain a high degree of risk and reputation management. They anticipate and quickly adapt to new regulations and operating requirements, ranging from dynamic changes in healthcare policies to decreased budgets. They effectively respond to the impact of an unexpected or unlikely negative event—for example, a contagious outbreak or epidemic. They also efficiently deploy new applications.

Yet healthcare organizations are challenged to quickly adapt to industry pressures and risks in their own environments while staying focused on consumer needs and patient-care quality. In the United States, for example, mandates provide both incentives and penalties to motivate providers to swiftly implement healthcare provisions in the American Recovery and Reinvestment Act (ARRA) and the Health Information Technology for Economic and Clinical Health (HITECH) Act.

To avoid heavy fines and damage to brand and reputation, providers must minimize the risk of breaches to patient records and protect patient privacy. They must be able to respond rapidly to unlikely events—from unforeseen health pandemics to potentially brand-damaging drug recalls or data breaches. Moreover, providers must also reduce risks associated with new accountable care organizations while extending applications to acquired or merged entities and quickly deploying new functionality in areas such as analytics and population management.

According to these key indicators, how agile is your organization? Are your business and IT environment cost-effectively adapting to all of healthcare's changes? How can you begin to optimize your virtualized infrastructure to actively identify and deploy services that improve care, significantly reduce costs while improving revenue cycle control, and effectively manage your risks and reputational threats?

Connecting Cloud Computing and Business Agility

Corporate decision makers link cloud computing directly to business agility.² Yet healthcare organizations have only recently begun to expand their virtualization investments to cloud infrastructure.

Cloud computing provides a dynamic, secure, and compliant solution that dramatically reduces IT service-delivery time. Healthcare organizations can begin with a public, private, or hybrid cloud deployment model that best meets their specific business requirements. Although the greatest IT cost and agility benefits will be achieved from a hybrid cloud, most healthcare organizations are reluctant to risk noncompliance with the Health Insurance Portability and Accountability Act (HIPAA) or leakage of personal health information (PHI). However, organizations can overcome these perceived challenges by using a cloud solution that embraces adaptive security and compliance.

² AbsolutData. "Business-Agility Survey." February 2011.

Table 1 highlights the most common cloud use cases for provider organizations.

PROVIDER CHALLENGE	BUSINESS AGILITY IMPACT
Reporting and mining clinical data to improve patient outcomes, comply with regulations, and manage costs	With cloud computing's on-demand scaling, providers provision infrastructure for analytics without upfront capital expenses or significant delays. Providers realize operating improvements while managing costs because they have the ability to scale infrastructure up and down, as needed.
Easily maintaining and scaling infrastructure for patient care and claims data	Multisourced infrastructure makes a shared pool of computing and storage resources available to participating hospitals, practices, clinics, and labs on a "pay-as-you-go" basis. Providers using this solution enhance revenue and capture operational improvements while reducing costs. Consolidation conserves capital, and providers realize revenue through improved claims management.
Cost-effectively managing data system incompatibility	A multisourced service solution enables providers to unify disparate data types without a large upfront investment, share information with payers or collaborating practices, and implement analytics tools. Cloud computing reduces IT infrastructure capital costs while improving operational processes with payers.
Storing, managing, and sharing high volumes of digital images	Deploying infrastructure-as-a-service (IaaS) or platform-as-a-service (PaaS) capabilities enables providers to leverage cloud-based storage and image sharing. Through the cloud, providers can efficiently and securely manage and share digital images with radiology specialists and affiliated practices or hospitals, reducing the need for in-house capacity and related costs and improving operational efficiency.

Table 1. Cloud Use Cases for Healthcare Provider Organizations

Cloud Computing and Standards

The National Institute of Standards and Technology (NIST) defines cloud computing as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models.³ NIST outlines a model for cloud computing based on a layered approach—from the base physical layer up to various service and management layers (see Figure 1).

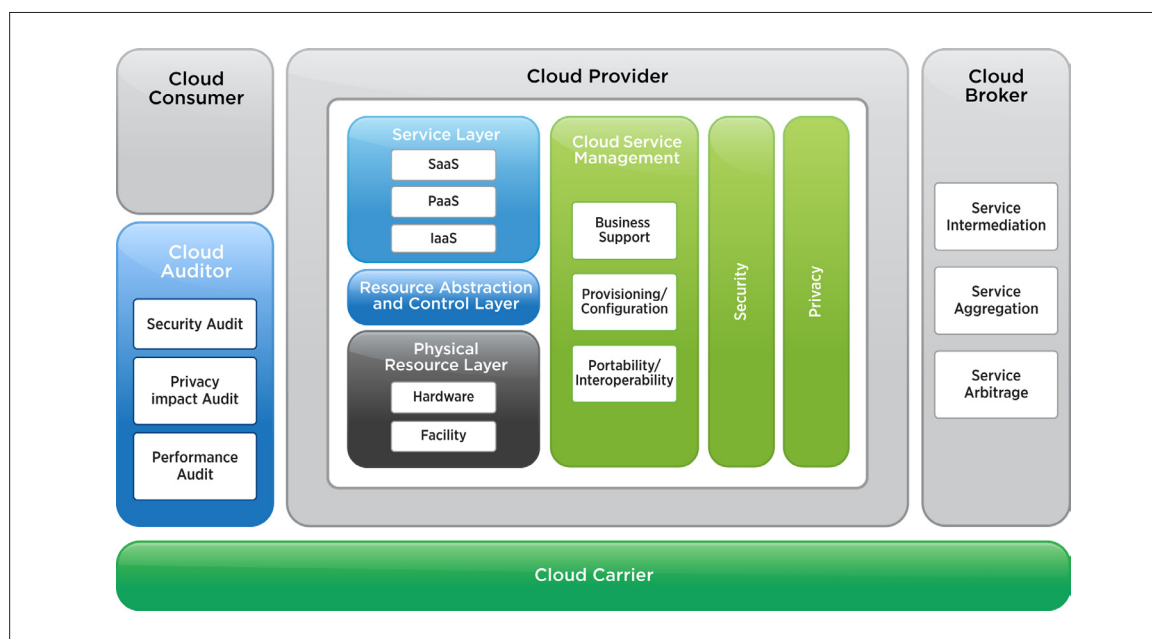


Figure 1. NIST Model of Cloud Computing

3. NIST. "The NIST Definition of Cloud Computing." Peter Mell and Timothy Grance, September 2011.

A key tenet of this cloud approach is the separation of computing into service or consumption models. This cloud approach involves understanding

- **Software as a service (SaaS)** – Examples include communications and collaboration applications, email, customer relationship management systems, and payroll, data sharing, and desktop applications.
- **Platform as a service (PaaS)** – Examples include application development and testing environments.
- **Infrastructure as a service (IaaS)** – Examples include Web hosting, bursting, storage, development and testing, and disaster-recovery solutions.

Moreover, NIST outlines four deployment models that are beneficial to organizations moving to a cloud approach:

- **Private cloud** – The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises.
- **Community cloud** – The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.
- **Public cloud** – The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.
- **Hybrid cloud** – The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds).

VMware has aligned with the NIST model of cloud computing, providing an integrated yet layered approach to cloud deployment. VMware vCloud® for Healthcare is the industry's first end-to-end care cloud computing platform for exchanging information and delivering products and services that can lead to better availability of healthcare systems. Flexible and customizable, it is specifically designed to support unique healthcare needs. With vCloud for Healthcare, organizations have the ability to layer in new capabilities over time. These capabilities support the entire IT care environment—from point-of-care to the most critical patient-care systems—to help safely accelerate the transition to truly connected care.

Infrastructure for the Next Generation of Healthcare IT

VMware is focused on helping healthcare providers build on existing investments and quickly realize the benefits of cloud computing. Initial VMware technologies helped IT teams save money through server consolidation and reduced space, power, and cooling requirements; these same organizations can now deliver healthcare IT as a service by deploying their EMR, health information exchange (HIE), and mobile applications on a more intelligent and automated platform. Using an open architecture, healthcare IT can extend VMware technologies to enable the software-defined data center.

The software-defined data center expands the power of virtualization and automation to all data center services—storage, networking, and security—delivering unprecedented efficiency, agility, and control (see Figure 2). It provides healthcare organizations with greater IT agility and efficiency, and ultimately helps providers transform the cost, quality, and delivery of patient care.



Figure 2. Delivery of Unprecedented Efficiency, Agility, and Control

Essential to the software-defined data center, virtualization and automation are required foundations for cloud computing. At the infrastructure level, virtualization enables providers to take much of the complexity associated with an application, as well as the middleware and even the operating system, and send it on a journey. With the ability to add new functionality—transparently and in a nondisruptive way—IT teams increase the efficiency, resilience, and ease of management for that application. They start to use the underlying infrastructure even more efficiently, moving collections of virtual machines to optimize the use of the total set of hardware in the data center—not just compute, but also storage, networking, and security resources.

Service Availability

The software-defined data center empowers healthcare IT to enable IT as a service by virtualizing all data center resources and applying policy-based automation. In this way, IT makes infrastructure available when and where clinicians and staff need it.

Yet before enabling a private, public, or hybrid cloud, healthcare IT must define what constitutes a service and have a solid understanding of the service layer. What services (e.g., servers, desktop, storage) should be exposed to which caregiver groups? What services will be needed to manage the cloud? Table 2 outlines some of the critical services providers need to manage in a cloud environment.

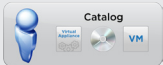
	Self-service	Enables end users to provision various system resources with minimal IT intervention
	Automated request and workflow	Supports building provisioning profiles and standards for self-service and automation
	Security and compliance	Provides a way to define and centrally manage security, compliance, and an audit model for all virtual machines and virtual desktop resources
	Automated operations management	Helps ensure that systems are appropriately managed with minimal IT intervention
	Automated disaster recovery	Enables alternate system resources to be deployed without IT intervention
	Server, storage, and network pooling	Supports aggregating, pooling, and then virtualizing compute, network, and storage resources as the way to enable the software-defined data center
	Extensibility (virtual and physical, multihypervisor, public cloud)	Extends a private data center cloud to a public cloud, resulting in an internally managed hybrid cloud

Table 2. Critical Services to Manage in a Cloud Environment

Beyond Compute to Network and Storage Virtualization

Once compute resources are virtualized, healthcare IT can move to virtualizing network resources. Like server virtualization, the VMware approach to network virtualization enables healthcare data center operators to treat their physical network as a pool of transport capacity that can be consumed and repurposed on demand. Virtual networks are programmatically created, provisioned, and managed, utilizing the underlying physical network for simple IP connectivity. VMware delivers the entire networking and security model (Layer 2 through Layer 7) in software. In addition, VMware virtual networks support existing applications, unchanged, on any physical network infrastructure.

By virtualizing the network, VMware provides a new operational model for networking that breaks through current physical network barriers. It enables healthcare organizations to achieve better speed and agility while reducing costs.

To enable even greater agility, VMware provides a virtual data plane that clusters server disks and flash technology to create high-performance, resilient shared storage designed for virtual machines. It will unlock a new tier of converged infrastructure that enables rapid and granular scaling of compute and storage resources. This means that healthcare IT will be able to deliver significantly lower TCO for point-of-care solutions built on VMware virtual desktop infrastructure (VDI).

vCloud for Healthcare brings together all of the elements healthcare IT needs to build, run, and maintain a complete cloud solution featuring a software-defined architecture. These elements enable healthcare IT teams to increase responsiveness to the business and to deliver the best service-level agreements (SLAs) to all applications—including the most patient-critical ones. In addition, these elements help IT simplify and automate IT management, enhancing productivity and creating more time for innovation.

Security in the Cloud

Although many providers have plans to move to a cloud model, initiatives are often complicated by the increasing number of regulatory compliance requirements, such as payment card industry (PCI), PHI, and HIPAA requirements, which necessitate the protection of data. Healthcare organizations are increasingly concerned with the complexity, risk, and impact new technologies may bring to existing environments.

To truly make a data center secure and compliant, providers must address every level—host, virtual server, network, applications, and data. Integrated industry security and compliance in vCloud for Healthcare unlock the benefits of cloud computing, lowering costs and accelerating IT agility by enabling healthcare providers to

- Deploy cost-effective and adaptive security services to build a trusted cloud infrastructure.
- Eliminate patchwork of security solutions and use a single policy framework.
- Easily integrate third-party solutions such as antivirus IP.
- Ensure compliance by isolating critical workloads and implementing compliance controls on virtual infrastructure.

Private Cloud Medical Imaging Saves Up to \$18,000 per Emergency Room Visit

The mission of eMix (Electronic Medical Information Exchange) is to provide medical images and information when and where they are needed. Instead of giving CDs to patients or setting up costly virtual private networks (VPNs) to transfer information between facilities, eMix enables medical facility subscribers to forward information directly to medical staff. The system, hosted at iLand on VMware cloud infrastructure, supports applications compliant with HIPAA. The scalable platform is in a logically separated and hosted private cloud, and the eMix gateway is typically provided as a virtual machine. In practice, transferring information and images over eMix—for example, when a patient goes straight to the operating room and bypasses emergency room rediagnosis—typically saves USD \$14,000–\$18,000.

Cloud Computing and Point of Care

Primary care physicians, on average, take on 28 percent more patients than they are able to handle. Even worse, patients typically have only 27 seconds to explain their symptoms before being interrupted by their physician. Studies have shown that up to 70 percent of patients are unsatisfied with their quality of care.⁴

By virtualizing clinical workspaces and hosting them in a private cloud, the VMware® AlwaysOn Point of Care™ solution in vCloud for Healthcare enables IT to provide the “last mile” of EMR delivery (see Figure 3). This tested and validated solution supports 24/7 access to patient-care applications and digitized patient data—anywhere and from any device.

With cloud-based technology, providers meet demands for greater mobility and calls to implement BYOD initiatives. IT can deploy an active-active clinical desktop environment to improve caregiver productivity. IT enables clinicians to save time by delivering and maintaining all information and applications, including files, across any of the platforms caregivers need to access throughout their day—such as PCs, workstations, iPads, and mobile devices.

From a device-independent workspace featuring single sign-on, clinicians gain freedom and near-native application functionality. At the same time, IT centrally maintains control, manages security, and reduces application deployment complexity. Whether caregivers are working in remote clinics, at acquired or merged entities, or at home, they can be quickly authorized or blocked from various applications according to their needs or roles. New applications can be deployed without concern for complex desktop integrations. Data is secured centrally and does not reside on endpoint devices—eliminating lost or stolen PHI concerns.

4 American Journal of Managed Care. “Virtual Health Assistants Poised to Revolutionize Healthcare Delivery.” Dr. Thomas Morrow, 2012.

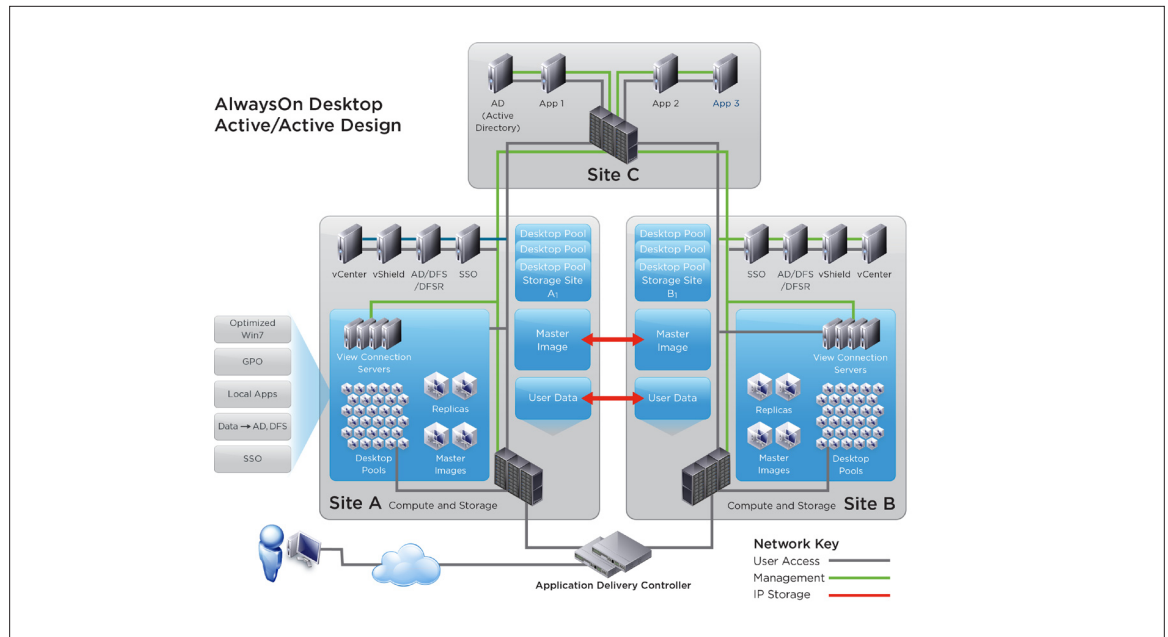


Figure 3. Nonstop Access to Clinician Workspaces and Patient-Care Applications

AlwaysOn Point of Care provides multiple levels of redundancy with no single point of failure. It runs identical desktop images, ensuring that a clinical workspace is always available. If the primary site fails or is compromised, clinicians still have access to the resources they require to do their jobs. In addition, the solution improves clinician workflow and enables caregivers to spend more time with patients.

For example, MidMichigan Health reports that the virtualized clinical desktop has made adoption of the EMR system go more smoothly. Providers find that the system is easy to use and highly available and that adoption has been less of an issue than expected. In addition, there has been an uptick in patient satisfaction, because the in-room workstations enable providers to spend more time with the patients in their rooms than in the halls.⁵

Hybrid Cloud Services

As traditional hospital infrastructure becomes more self-service-oriented, VMware helps healthcare IT enable compliant, secure hybrid clouds. These clouds bring together private and public clouds into a platform that further enables patient-care innovation. Today, healthcare IT can use VMware vCloud® Hybrid Service™ to extend the same skills, tools, networking, and security models across both onsite and offsite environments.

Healthcare ISV Considerations

Traditionally, healthcare ISVs have tightly controlled both their applications and the IT environments in which they run. Many ISVs have sold and deployed infrastructure along with their applications or they have certified particular infrastructure before deployment. These traditions are changing as IT environments become more standards-based and resilient.

Cloud-like models are not new for leading healthcare ISVs. One third-party developer has even begun discussing an all-in-one approach for platform services. Additionally, service providers have built storage-cloud capabilities to house the medical image archives that are growing exponentially. These factors, and the continued merger and acquisition activity in the healthcare marketplace, make the exploration of cloud models for all business and patient-care applications more urgent.

⁵ IDC. "Virtualizing the Clinical Desktop: The Bridge to an Improved Provider Experience." Judy Hanover, August 2011.

Transition to the Cloud with VMware

To maintain cost and competitive advantage in today's transformed healthcare market, providers must begin to explore how cloud computing can benefit their organizations. With vCloud for Healthcare, providers have all of the components necessary to transition an existing IT environment into an on-demand service model, including optimized tools to automate cloud management (see Figure 4).

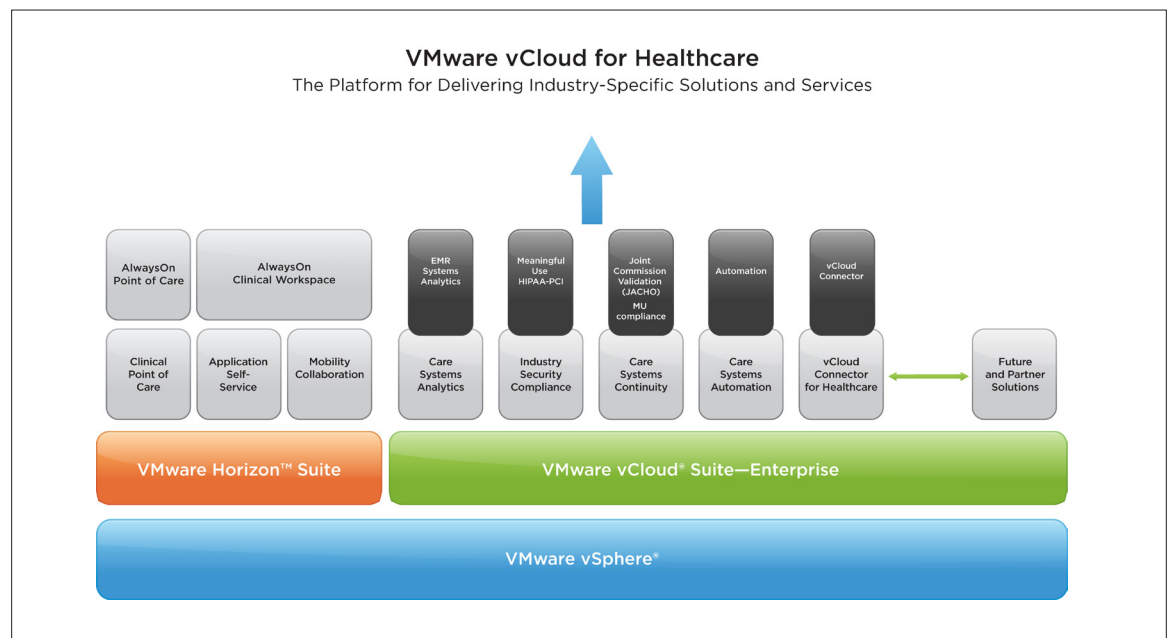


Figure 4. Transforming the Cost, Quality, and Delivery of Patient Care While Enabling Proactive Compliance for the Cloud

The following technologies are included in vCloud for Healthcare to address requirements for healthcare IT cloud computing:

- **Clinical point of care** – Save time and improve workflows with secure authentication (e.g., the touch of a finger or tap of a badge) to clinical workspaces and patient-care applications.
- **Application management and catalog services** – Streamline processes with efficient self-service access and management of approved end-user applications.
- **Mobility collaboration** – Improve connected care with access to patient-care applications, including EMR and computerized physician order entry (CPOE) systems, from any device, anywhere.
- **Care systems analytics** – Reduce downtime of critical patient-care applications and remediate issues before they affect end users.
- **Industry security compliance** – Enable proactive regulatory compliance for the cloud and deliver dynamic clinical IT services in a trusted infrastructure.
- **Care systems continuity** – Keep systems up and running.
- **Care systems automation** – Improve efficiency by simplifying and automating IT operations.
- **VMware vCloud® Connector™ for healthcare** – Help ensure that regulated workloads can be safely moved to public clouds by means of a hybrid model.

VMware Professional Services

VMware experts are available to assist your healthcare organization in converting IT possibilities into real business value. The extensive VMware services community comprises VMware Professional Services and select service-delivery partners with global experience in the healthcare industry and with the vCloud for Healthcare solution. Providers can address the technical, people, process, and financial aspects of IT transformation by taking advantage of the comprehensive VMware services portfolio shown in Table 3.

Accelerate Advisory Services	Benchmarking and financial modeling analysis to identify transformation opportunities and create executable IT strategies that support business goals.
Cloud Operations Services	Insight, prioritized recommendations, and expert guidance to change operational processes and organizational structures, and apply financial models to realize the greatest value from private, public, and hybrid cloud environments.
Technology Consulting Services	Real-world experience that helps create, expand, or optimize a software-defined data center and end-user computing environment to deliver material outcomes while providing hands-on knowledge transfer that builds team self-sufficiency.
Technical Account Manager Services	Advocacy that continually enriches provider strategies and tactics for driving change over time and helps improve provider support for VMware projects.
Education Services and Certification Programs	In-person and online sessions to help build the skills, confidence, and experience needed to effectively design, operate, and leverage VMware technologies.

Table 3. VMware Services

Team with VMware to Accelerate Innovation

Cloud computing and the promise of significant benefits from the cloud vision are not new. Although many companies provide their own definitions, the NIST model (discussed earlier) offers the most logical, comprehensive, and vendor-neutral concept of cloud deployment. VMware technologies align well with the NIST model, providing a modular and comprehensive approach to moving IT services into cloud services—in a private, public, and hybrid cloud model.

The right cloud architecture for your business begins with a solid strategy. VMware provides solutions and expertise to help you develop and execute on the model that best supports your mission-critical healthcare applications. From the security and compliance model to monitoring dashboards and disaster-recovery tools in vCloud for Healthcare, VMware is focused on helping providers remove IT complexity, meet meaningful use requirements, improve outcomes, and reduce costs. Whether your organization is just considering or has already begun its cloud journey with virtualization, VMware can help.

VMware has unparalleled experience, more than half a million customers, a large partner ecosystem, and unique solutions designed specifically for healthcare IT to reduce the cost, quality, and delivery of patient care. Engage with VMware to move your healthcare organization to the cloud, accelerating IT and business agility.

Learn more at <http://www.vmware.com/go/healthcare>.



VMware, Inc. 3401 Hillview Avenue Palo Alto CA 94304 USA Tel 877-486-9273 Fax 650-427-5001 www.vmware.com

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