

Exadata Cloud Accelerates Healthcare Workloads and Lowers Costs

Today's healthcare organizations must manage massive amounts of data, keep it safe, and use it to improve patient outcomes – all while keeping costs under control. Decision makers have changed how they evaluate technologies, and Oracle's Exadata cloud solutions are at the forefront of providing the performance, scale, security, and low costs they demand.



Oracle Exadata is co-engineered with Oracle Database and Autonomous Database for cloud and on-premises deployments.

THE EVOLVING HEALTHCARE CHALLENGE

Improving patient experiences, population health, and clinician satisfaction are recognized by the healthcare industry as top priorities. In addition, individualized therapies have been developed that require the analysis of extensive amounts of comprehensive medical information to drive better patient outcomes. At the same time, there is a growing shift from fee-for-service reimbursement models to new value-based ones that may introduce additional financial risks for organizations that do not adequately leverage data.

Achieving these seemingly divergent goals simultaneously requires that healthcare organizations integrate data from multiple sources using industry standard interchange formats, securely store it for a person's lifetime, and analyze it in near real-time. They must also be able to appropriately share portions of it with external specialists, researchers, and public health officials while maintaining the highest level of patient privacy. How healthcare organizations manage and analyze their data is increasingly their key to success.

THE BEST DATABASE PLATFORM FOR HEALTHCARE SERVICES

Databases storing patient records, images, and videos are central to healthcare organizations' ability to provide the highest level of patient services and deliver positive outcomes. As data expands in healthcare information systems and the need to analyze it in real time intensifies, healthcare organizations are looking at high-performance database cloud services to store, process, and protect patient data. Exadata Database and Autonomous Database cloud services integrate unique capabilities that are coengineered with Exadata infrastructure so healthcare organizations can efficiently store and rapidly process all types of data, protect it, and reduce costs. Scalable and highly available Exadata platforms are

Key capabilities:

- High-availability hardware and software with single-click disaster recovery provisioning provide continuous access to patient information
- Oracle Database and OCI features increase security and help customers meet regulatory requirements
- Independently scalable database performance and capacity increases flexibility
- Built-in cloud automation simplifies IT operations
- Online consumption scaling simultaneously optimizes performance and lowers cost
- Exadata Cloud@Customer provides data sovereignty in customer data centers
- Autonomous Database support in OCI and customer data centers enables industry-leading auto-provisioning, auto-scaling, and auto-securing capabilities

available in Oracle Cloud Infrastructure (OCI) regions and as Cloud@Customer solutions in customer data centers so healthcare organizations can deliver better outcomes to more patients and meet complex regulatory requirements. A few of the potential use cases for Exadata cloud solutions in healthcare include:

Healthcare Use Cases	Autonomous Database and Exadata Cloud Benefits
Electronic Health Records	Improve patient and clinician user experiences with faster and more reliable access to secure, up-to-date information
Predictive analytics	Improve the quality of care and patient outcomes by identifying potential issues before they occur
Telemedicine	Provide more timely care and lower expenses for patients and providers while reducing risks for clinicians
Research on reducing treatment costs	Evaluate the efficacy of different treatment methods to improve the quality of care and reduce costs
Back office automation	Improve productivity and reduce costs with enhanced performance, simplified management, and continuous operations
Fraud detection	Rapidly identify fraudulent transactions with real-time analysis of enterprise-wide data using graph analytics

Exadata Database and Autonomous Database services are available in both OCI regions and in customer data centers. Exadata Cloud@Customer infrastructure allows healthcare organizations to take full advantage of service and platform innovations for all database workloads, no matter where they run.



Figure 1: Exadata cloud deployment options

ENSURING PATIENT DATA PRIVACY

As healthcare organizations complete their move to electronic records, complying with legal requirements to protect privacy and security of electronic protected health information (PHI) has become paramount. But, it's not just standard patient records that need to be protected – genomic data, telemedicine sessions, and claims data must all be secured against access, theft, and ransomware. Privacy regulations, such as GDPR, require continuous improvements against new types of cybersecurity threats and impose stiff penalties for those unprepared to address them. Autonomous Database and Exadata Database Service securely run enterprise database workloads in the OCI regions, enforce always-on encryption with customer-controlled keys, and apply Oracle Database Security best practices so information is protected against unauthorized access at-rest, in-motion, and when stored in database backups or archives.

Healthcare organizations want to use public clouds to lower costs and increase agility and availability, but sometimes they are unable to do so. While many clouds, including Oracle's, provide HIPAA capabilities to address core privacy requirements. However, data sovereignty and security regulations, or a need for low-latency connectivity to existing on-premises resources may prevent the migration of data and applications to the public cloud. Exadata Cloud@Customer brings Autonomous Database and Exadata Database Service inside customer data centers, enabling healthcare organizations to gain cloud benefits such as reduced

Exadata Cloud@Customer in action

The Mexican state of Querétaro was able to quickly identify and treat tens of thousands of COVID-19 patients, while preventing overcrowding at hospitals using a Java application that uses databases on Oracle Exadata Cloud@Customer.

- Flexibility of a cloud-based system in their data center
- Lower costs using cloud economics
- Securely keeps data behind their firewall

“With Oracle Exadata Cloud@Customer, we've not only been able to keep all of the data behind our own firewalls, but we also can now extend custom web and mobile services to citizens and public officials.”

**Pedro Toscuento,
Director at the Center of
Information and Analysis
Queretaro (CIAS)**

manual database lifecycle management and lower costs with automation and pay-per-use economics while simultaneously meeting strict data sovereignty and security requirements.

As an Oracle-managed service, Exadata Cloud@Customer protected against internal and external threats as well as against unauthorized access by the Oracle Cloud staff. All Oracle Cloud databases require that customer data be encrypted, and with customer owned encryption keys Oracle can never view the underlying data. On top of that, Oracle's Operator Access Control allows healthcare organizations to completely control when Oracle Cloud operators can access Exadata Cloud@Customer infrastructure and what they can do when they access it. Customers can monitor and log every keystroke or action Oracle operators take, and access can be revoked by the customer at any time with all operator-initiated activities immediately halted. These controls are included at no additional cost as part of the Exadata Cloud@Customer service.

SECURING HEALTHCARE DATA

Protecting patient privacy is crucial, but security efforts don't stop with preventing unauthorized access. Healthcare providers, payers, researchers, and public health organizations also have to safeguard their entire data estate against increasingly frequent ransomware attacks.

Oracle Database provides the foundation for cloud database security with advanced security capabilities that help to protect all types of databases. For example, technologies such Database Vault protect against privileged user access while Data Masking and Sub-setting help remove sensitive data from data sets used for development, testing, and reporting purposes. Exadata cloud solutions, including self-securing Autonomous Database environments, build on these core Oracle Database security capabilities by combining always-on encryption with OCI's artificial intelligence and machine learning based threat detection and remediation. In addition, Oracle Data Safe provides a unified security control center that helps DBAs and security teams understand the sensitivity of enterprise-wide data, evaluate risks to that data, and address security compliance requirements – at no extra cost.

Consolidating disparate databases on Exadata infrastructure also allows organizations to employ a single security model for all their databases, whether they are transactional or analytical. Consolidation on Exadata Database services eliminates security fragmentation that results from having different security models on stand-alone cloud databases, and reduces the chance of misconfiguring security settings. Using Autonomous Database's automatic patching and security capabilities takes this a step farther by providing quicker protection against emerging threats and eliminating additional sources of human errors.

Oracle's Zero Data Loss Recovery Appliance is instrumental in helping healthcare organizations recover from ransomware attacks by providing continuous data protection that enables recovery to the instant before an attack takes place and by automating the recovery process to minimize the length of an outage. Recovery Appliance helps organizations eliminate the need for lengthy full backups, log every database change in realtime on a separate system, and implement CyberVault architecture that prevents intrusions from propagating from the database system to data protection platform. When combined with always-on database encryption, the Recovery Appliance's data immutability helps organizations meet stringent healthcare data protection and rapid recovery requirements.

INCREASING HEALTHCARE DATA AVAILABILITY

Exadata cloud infrastructure provides the high availability, data protection, and disaster recovery capabilities that healthcare providers require to support continuous operations. Exadata's scale-out architecture integrates redundant hardware components, fault-tolerant software capabilities, and built-in Maximum

"Oracle Autonomous Database and Oracle Cloud Infrastructure's high availability lets us both stay more relaxed and be more proactive in the deployment of services that the hospital needs."

**Juan José Salazar
Comptroller,
San Javier Hospital**

"Oracle Exadata Cloud@Customer brings trust and resilience so we can focus on support and adjustment activities within the patient care solution."

**Rodrigo Gosling
Chief Technology Officer,
A.C. Camargo Cancer Center**

Availability Architecture (MAA) best practices that have been developed over more than 20 years to support 24x7 mission-critical database operations. Exadata Cloud platforms virtually eliminate planned downtime by allowing customers to scale database consumption up or down without interrupting services—a capability not provided by most cloud databases, and with online patching, upgrading, and maintenance of crucial database hardware and software infrastructure so updates don't cause database and application outages.

To reduce potential data loss due to equipment failures and ransomware attacks, healthcare organizations can provide continuous data protection for databases running on Exadata Cloud Cloud@Customer by using Oracle's Zero Data Loss Recovery Appliance. The Recovery Appliance immediately protects crucial data as changes occur, continuously validates data, and automates much of the database recovery process, allowing organizations to quickly recover to any point in time prior to a failure, human error, or cyberattack.

ACCELERATING HEALTHCARE ANALYTICS

Healthcare analytics help organizations use current and historical data to predict patient outcomes, identify emerging health-related trends, improve community outreach, and better manage the spread of diseases. When combined with business intelligence suites and data visualization tools, healthcare analytics enable managers to gain real-time insights that allow them to make decisions that improve healthcare outcomes and reduce costs.

However, the amount of data being analyzed in both research and clinical environments is rapidly expanding, and the ability to analyze multi-terabyte to petabyte data sets exceeds the capabilities of many database cloud services. Autonomous Database and Exadata Database cloud services running on scalable Exadata infrastructure allow organizations to manage, and rapidly analyze large transactional databases and data warehouses. By using unique technologies such as Exadata Smart Scan, Smart Flash Cache, and Database In-Memory, organizations can quickly analyze large data sets with advanced analytics and ML algorithms that take advantage of hundreds of gigabytes per second of scan throughput on intelligent storage servers.

Many healthcare organizations also need to perform analytics in real-time to better understand patient needs and identify potential problems before they become critical. Exadata Database and Autonomous Database services allow healthcare organizations to perform analytics on transactional databases in support of real-time alerts and telemedicine use cases. By eliminating the need for complex and time-consuming ETL (extraction, transform, and load) processes and, instead, processing incoming data with in-database analytics and ML models, patient outcomes can be improved in real-time.

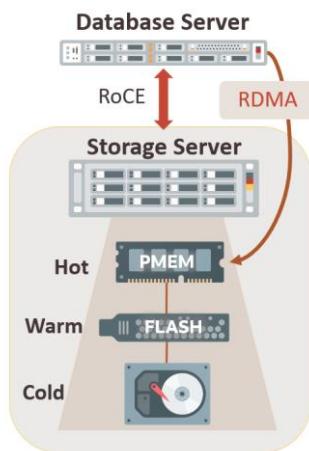
The cost of analyzing large databases is also a concern for healthcare organizations that are always looking to provide more services at lower costs. Exadata cloud platforms help minimize the cost of running analytics by delivering higher performance per vCPU, enabling online scaling of cloud database resources, and reducing the amount of storage required. Since time literally is money in the cloud, higher per vCPU performance lowers costs by reducing the number of vCPU-seconds consumed by a particular analysis. In addition, online dynamic resource scaling eliminates the need to overprovision resources to meet peak requirements – something that's required by many cloud database services.

DEVELOPING INNOVATIVE APPLICATIONS

When healthcare organizations move to the cloud and modernize their processes, they are increasingly turning to machine learning (ML) and automation to identify patient-specific issues, reduce clinical workloads, and improve operational efficiency. Software providers—including Oracle with its Health Foundation and Oracle SaaS applications—can use Exadata cloud platforms to build ML into their applications without having to add dedicated services for it. ML models run against newly ingested data and historical information in near real-time within

"Oracle achieves the maximum identically between on-premises and public cloud, giving CxOs the peace of mind to operate workloads where they can best be run and operated."

Holger Mueller, Vice President and Principal Analyst, Constellation Research



Oracle Exadata with database-transparent persistent memory

Exadata Database and Autonomous Database, eliminating time-consuming data export and reformatting that can lead to security risks because multiple copies of data have different security models.

Many organizations develop and deploy their own applications to monitor results and distribute information to their stakeholders. Oracle includes numerous application development tools and frameworks within the Autonomous Database and Exadata cloud solutions to help control development costs. For instance, Oracle Application Express (APEX), included in Autonomous Database, is a fully managed, low-code application development platform for building and deploying modern data-driven applications in Oracle Cloud. Application developers and “power users” can create enterprise applications 38x faster and with up to 95% less code, all without having to learn complex web technologies.

LOWERING COSTS WITH EXADATA CLOUD

Many new healthcare service providers were born in the cloud and rely on generic infrastructure and simplified processes to run their businesses. Subscription-based cloud resource consumption allows them to lower their costs and easily deploy scale-out applications. However, the mission-critical requirements for healthcare databases that underlay many new applications need levels of performance, scale, and availability that exceed the capabilities of generic cloud infrastructures.

Healthcare organizations using Oracle Autonomous Database on Exadata infrastructure in OCI regions or Exadata Cloud@Customer in their data centers are able to achieve higher levels of performance, scalability, and availability than are provided by similar services from other cloud providers. Oracle Cloud database solutions allow customers to run transactional databases, data warehouses, and mixed workloads on the same, secure infrastructure in any location while reducing costs by automating many manual management tasks and dynamically scaling resource consumption to match current workload demand.

Exadata Database Service on OCI is the key enabling technology for healthcare organizations to move to the cloud. The service allows customers to achieve the highest levels of performance with the largest Oracle databases in the cloud and efficiently consolidate them to reduce costs. Unlike other cloud database services that limit customer databases to the performance of a single database server, Exadata Database Service on Dedicated Infrastructure can scale up to 3,200 vCPUs in database servers, another 6,000 vCPUs worth of processing power in intelligent storage servers, and over 3 TB of usable storage. These capabilities allow customers to deploy support 20X larger uncompressed databases and over 50X larger data warehouses, provide up to 25X more processing power, and access data in as little as 19 microseconds, 50X faster than other cloud database services.

Finally, one of the costs that healthcare organizations face when moving to the cloud is the cost of converting databases and applications to run in a different environment. Oracle Autonomous Database and Exadata Database Service are compatible with existing on-premises Oracle Database deployments so moving to OCI or Cloud@Customer infrastructure requires less work, eliminating the need to spend millions of dollars and years to restructure workloads to run in a different environment.

EFFICIENT DATABASE CONSOLIDATION

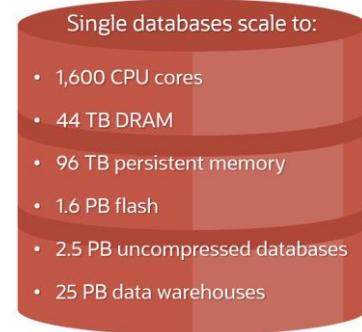
As many healthcare service providers have learned, it's easy to create hundreds or thousands of stand-alone databases in on-premises and cloud environments, but difficult and expensive to manage them. Database and infrastructure sprawl can lead to higher infrastructure and software costs as well as data silos, fragmented security and compliance gaps. Converged Oracle Database capabilities running with Autonomous Database or Exadata Database services reduce the complexity, costs, and inconsistent security generated by database sprawl.

“Oracle Autonomous Database is the world’s best database with a broad set of advanced functionalities and ties into easy-to-use tools, which includes APEX for free, that accelerate our time to market with zero database administration.”

Steven Chamberlin
CEO, Sensa Analytics

“Wikibon believes that the Oracle Exadata Cloud Service offers the lowest cost option of moving to the cloud for enterprises with significant investments in Oracle Databases.”

David Foyer, CTO, Wikibon



Exadata Database Service on OCI

Oracle Database supports multiple data types, database models, and development paradigms, enabling developers to quickly develop applications with rich data models without having to integrate data from multiple databases using different APIs. Consolidating converged Oracle Database instances on Exadata means that all databases and use cases benefit from high performance, availability, and security, so weak links in the data chain don't take down an entire application or enable a breach of patient data or financial information.

Consolidating databases with Exadata cloud infrastructure allows organizations to more efficiently use software and hardware resources when running multiple workloads and workload types. All database workloads benefit from fast Exadata performance and have access to shared pools of resources to increase processing and storage capacity when needed. Shared pools of resources also make it quick and easy to provision new databases since completely new cloud instances or on-premises resources do not need to be deployed.

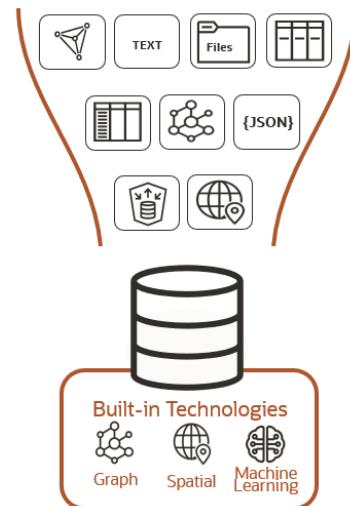
Managing converged databases on Exadata cloud infrastructure is also easier since there are fewer databases and less infrastructure to maintain. The infrastructure for all database instances is managed and patched by Oracle, while Autonomous Database further simplifies database management by eliminating the need for DBAs to configure, tune, patch, and secure the database software itself.

SUMMARY

The time to move databases for healthcare services to the cloud has come, and the combination of Oracle Autonomous Database and Exadata Database services provide the best capabilities to stay ahead of ongoing industry trends.

Compatibility with on-premises Oracle Database and Exadata systems, and availability in OCI regions and customer data centers enable customers to easily move workloads to cloud infrastructure while meeting data sovereignty, security, and latency requirements.

Exadata Cloud solutions deliver the performance, scale, availability, and security healthcare organizations require to run crucial applications in the cloud. Oracle Cloud automation, built-in Exadata management automation, and the ability to run Autonomous Database in OCI regions or customer data centers allow healthcare providers to spend less time and money on maintaining infrastructure and more on innovations that improve the quality of patient care and outcomes, lower costs, and reduce financial risks.



Consolidation with Oracle Database converged capabilities

For more information on Exadata solutions, visit:

- [Exadata Database Service](#)
- [Autonomous Database](#)
- [Exadata Cloud@Customer](#)
- [Autonomous Database on Exadata Cloud@Customer](#)
- [Oracle Exadata Database Machine](#)

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