



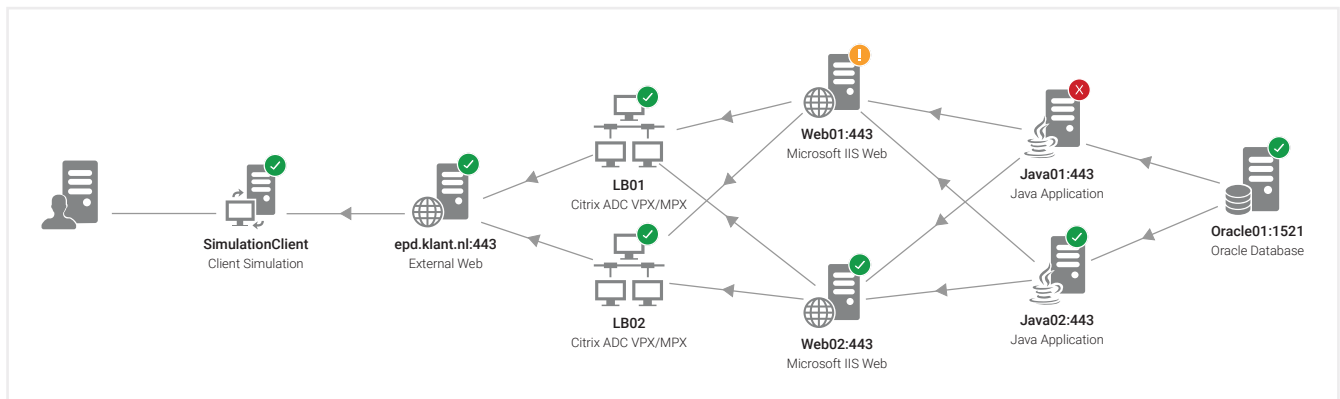
eG Innovations

Seven Essential Features for Effective APM in Healthcare



Hospitals and healthcare providers are continually embracing digital change to offer new services and deliver better experiences and outcomes for healthcare professionals and patients. Modernizing healthcare records, appointment booking systems, web services and the finance and management operations of hospitals has led to the widespread adoption of several key application platforms and frameworks, including:

- ➔ Electronic health record (EHR) systems such as Epic, Cerner, Meditech, Veradigm (formerly Allscripts), Chipsoft HiX, and Nexus
- ➔ Applications to support HR, administration, research, finance, and facilities management,
- ➔ Patient portals
- ➔ Cloud platforms and services on Microsoft Azure, Amazon Web Service (AWS) and others
- ➔ Virtualizing specific applications often for remote access via Software-as-a Service (SaaS), Virtual Desktop Infrastructure (VDI), Desktop as a Service (DaaS) and technologies from vendors such as Citrix, VMware, and others



A common healthcare Java application delivery stack we see includes web servers, load balancing, IIS servers, Java applications servers and databases.

Adoption of application platforms and frameworks has benefited healthcare workers and patients alike, but reliance on third-party functionality comes with increased demands on IT operations teams to implement, configure, and ensure performance and availability. When issues arise, IT administrators may need to isolate the problem and rely on the response of third-party support services and if leveraging custom-built applications, they will need the tools and skills to identify and resolve issues in-house.

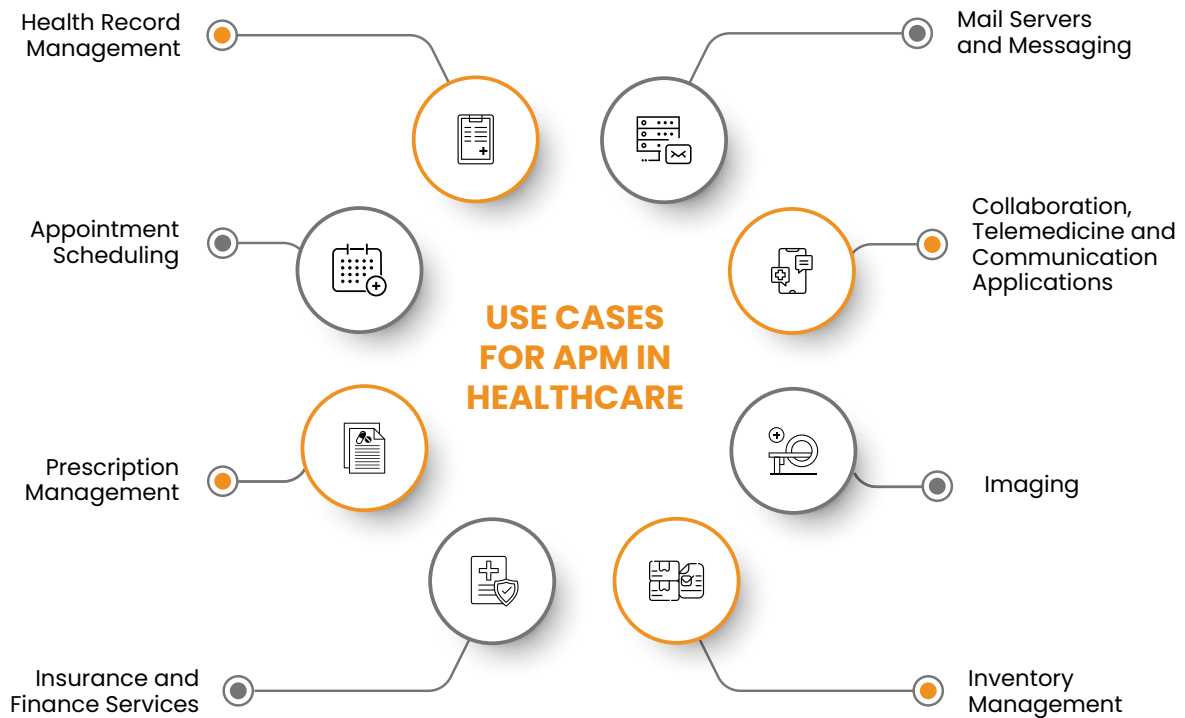
While cloud platforms offer Service Level Agreements (SLAs) for their infrastructure, it is the IT administrator's responsibility to ensure any applications and services deployed in Cloud are available to employees and those seeking care, usually 24x7.

In this eBook, we will cover the key elements needed for a proactive Application Performance Monitoring (APM) strategy in healthcare and the benefits of adopting such a strategy. This will help construct a roadmap for your healthcare organization, quantify the value, and cover key features APM solutions should possess to support specific healthcare application platforms and services.

Use Cases for APM in Healthcare

Good APM observability platforms and monitoring tools help ensure the smooth operation of key patient-focused functions such as appointment booking, prescribing, sharing medical test results, insurance claims, staff rostering, and patient care records.

Important demand-driven use cases may include:



The Imperatives for Implementing APM in Healthcare

Healthcare IT teams are often required to justify the benefits of adopting APM tools. A few are listed here.

Proactive Patient Safety

Ensuring patient safety is the highest priority in healthcare. By proactively averting or detecting and addressing application performance issues, APM contributes directly to patient safety. Robust APM ensures the optimal performance of critical healthcare applications, contributing to patient care by guaranteeing timely access to medical data and uninterrupted healthcare services.

Enabling Modern Healthcare Delivery

Digitizing healthcare applications, patient services and administration tools frees healthcare providers from many of the constraints of physical infrastructure and physical clinic sites. Patients can access many services remotely in ways that enhance accessibility. Staff training can be provided more conveniently via e-learning courses. Healthcare organizations can expand to satellite clinics in other locations or cities, offering specialist services to patients who might have difficulty attending primary sites. Clinicians can seek specialist second opinions via collaboration applications with experts in other regions or even countries. APM ensures that these key benefits are achieved with applications available 24x7.

Free IT Teams from Troubleshooting

Proactively monitoring applications and infrastructures for signs of issues before they become significant and before healthcare professionals encounter them and raise help desk tickets reduces the time healthcare IT Ops must spend verifying and processing support cases. This leaves them time to focus on long-term and strategic IT projects.

Adopting automated root-cause diagnosis technologies that can identify the tier or application stack where issues arise avoids the need for manual and time-consuming investigations and removes the inefficiencies of investigating the wrong tier.

Right-size and Capacity Plan to Reduce Costs

Good application and infrastructure monitoring and management collect sufficient information to enable IT departments to optimize costs. Beyond this, they demonstrate the value they add, future capacity expansion needs, and the costs of failing to modernize legacy systems, thereby justifying budgets. Providing an overall view of the impacts and values of application delivery linked to comprehensive data highlights the value and importance of the IT team to finance and management authorities.

Improved Security and Governance

Proactive monitoring of applications and user access is key to protecting patient records and research data, as well as to meeting regulatory compliance standards. It also ensures healthcare organizations are safeguarded against disruptive malicious cyber security breaches and attacks.

Comprehensive live and historical reporting can automate auditing activities and contribute to KPIs for governance and quality reporting. Data-driven IT management reports enable healthcare organizations to demonstrate their success and commitment to compliance requirements.

Seven Key Features for Effective APM

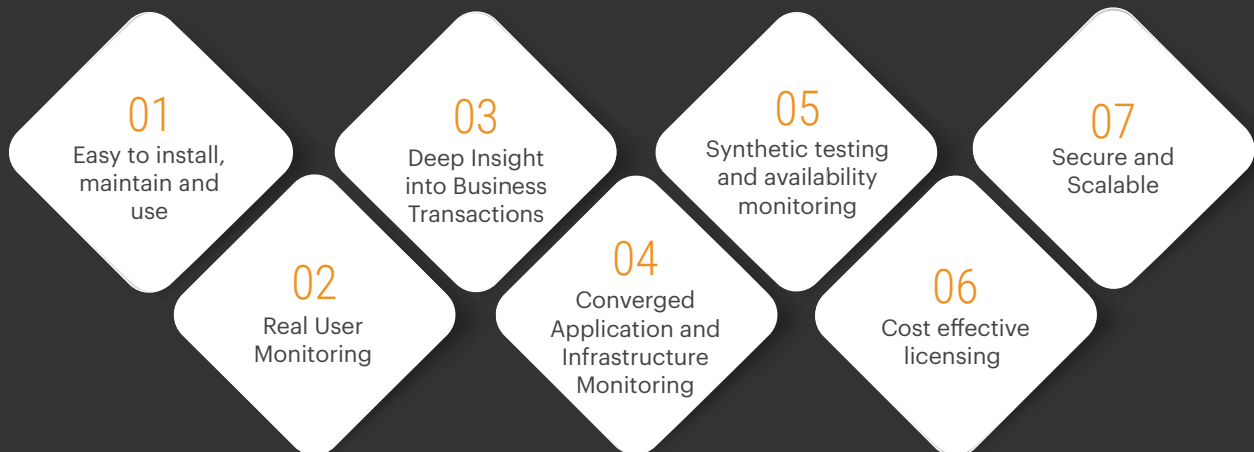
Healthcare IT environments are mission-critical, operating around the clock, 365 days a year. As technologies evolve the applications required to deliver effective patient care change, and patients access content and services in new ways with elevated expectations. Healthcare IT teams must deploy an extremely broad range of applications and services, ranging from core finance, patient record, and HR functionality to demanding 3D imaging applications and smart devices.

IT teams support delivery to a wide range of locations with varying quality of infrastructure, including hospitals, supplies warehousing, offices, community clinics and remote access for patients and staff. Seasonal viruses or public health scares can cause surges in demand for care or information.

With numerous applications built on technologies such as Java, .NET, Node.js and PHP, delivered on application servers such as Apache Tomcat, IBM WebSphere, Oracle WebLogic and JBoss, the IT administrators need continual insight into their performance. This insight should be provided in a simple, intuitive way that does not require developer tools or coding experience and is highly automated to alert on issues and identify root-causes of issues automatically.

If applications are delivered via platforms such as Citrix or VMware, the Desktop Administrator needs similar insights into application performance to differentiate application issues from VDI/DaaS challenges.

Any observability tool or platform adopted must offer key features:



01 Easy to install, maintain and use

eG Enterprise is straightforward and easy to install, utilizing best practice auto-discovery and topology mapping to understand and deploy across application and infrastructure architectures. It is designed to automatically adjust to changes and auto-scaling that may occur in environments such as Kubernetes or VDI, where additional containers, Virtual Machines (VMs), or application servers may be spun-up automatically.

With Universal Agent technology, there is no need for different agents for different technologies, simplifying integration with Infrastructure as Code (IaC) workflows and container platforms. Auto-discovery reduces setup time for the monitoring system, allowing fast rollout and enabling IT teams to focus on responding to alerts.

The eG Universal Monitor facilitates unified IT monitoring of 500+ applications and infrastructure components, providing performance monitoring insights into end-user experience, business transactions, applications, and the supporting infrastructure (physical, virtual and cloud). Administrators can choose between agent-based and agentless monitoring options, offering flexibility.

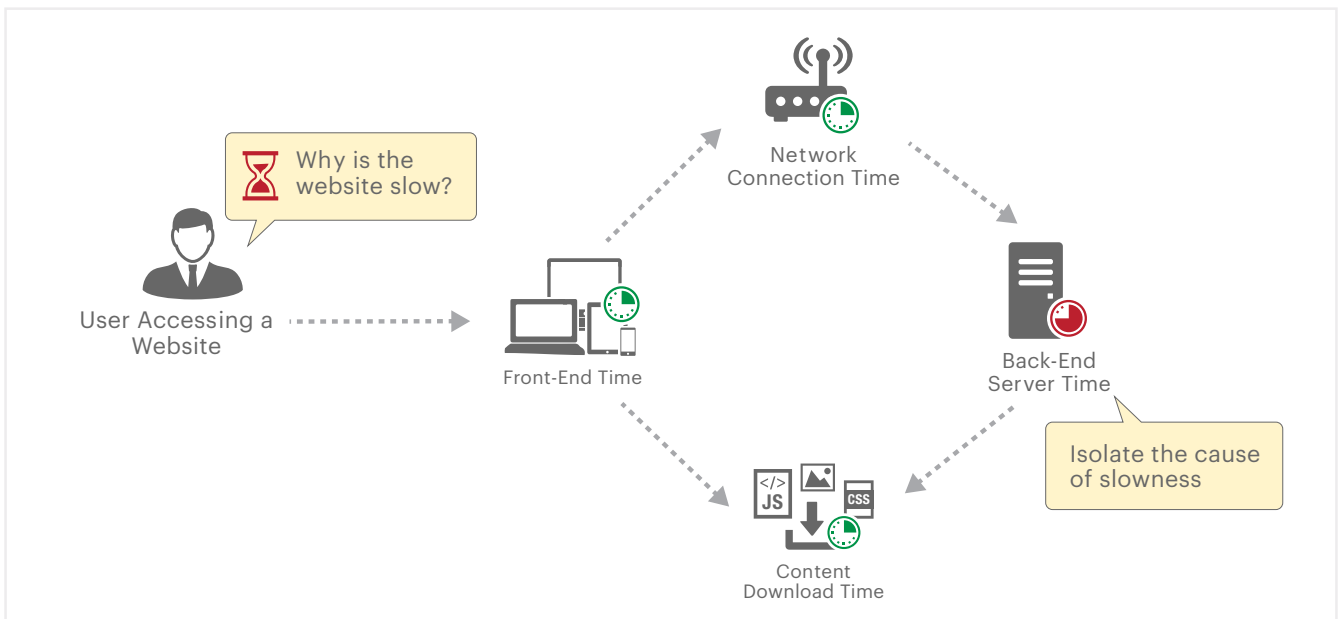
Deployment is straightforward - eG Enterprise can be loaded in a gold image and configured on-the-fly to monitor different applications or servers. A single universal agent encompasses all the monitoring capabilities needed for operating systems, application logs, processes, Java Virtual Machines (JVMs), web containers, transactions etc. In contrast, many other solutions require a separate “machine” agent for the OS an “application” agent for each application instance.

Once deployed eG Enterprise is designed to be simple and intuitive to use even for non-domain experts, eliminating the need for additional tools. Role Based Access Control (RBAC) and role-based dashboards enable persona-driven unified visualization, catering to distinct roles in an IT organization such as AppDevs, DevOps, Help Desk, IT Ops, VDI / Desktop Administrators and more.

02 Real User Monitoring

[Real User Monitoring](#) (RUM) is a passive monitoring technology that analyzes all user interactions with a website or client interacting with a server or cloud-based application. Monitoring actual user interaction

with a website or an application is important for operators to determine if users are being served quickly and without errors and, if not, which part of a business process is failing. RUM can be implemented in diverse ways:



- ➔ Many applications capture and report user experience (for example, with Citrix access, ICA/HDX latency is captured for each user session)
- ➔ User experience can also be monitored by deploying agents on user terminals
- ➔ Network taps/probes can also be used to observe user interactions and report user experience
- ➔ For web applications, a common method of tracking user experience is using JavaScript injection

What is JavaScript Injection?

A small JavaScript code snippet is introduced in application web pages being served to clients. When each client downloads the application content, it also downloads and executes the JavaScript code snippet. This snippet reports details about the client (IP address, location, browser version etc.), the page being accessed (URL, query string, etc.) and the performance experienced by the client (page load time, JavaScript errors, etc.)

The ideal approach for an organization depends on the degree of control you have over the endpoints, network, application, etc. For instance, if you are the application owner, it may be difficult to tap into the network or have agents on all the endpoints. In such cases, JavaScript injection may be the ideal approach.

eG Enterprise captures the real-user experience of patients and staff accessing applications allowing IT operations to identify long-term slowdowns, trends and problems affecting groups of users or specific applications. Collecting this data proactively ensures that complaints and issues raised with help desk can be retrospectively investigated with meaningful data. This is an important capability, as staff are often unable to access IT support immediately if they are busy focusing on patient care.

Additionally, a range of features allow deep drill-down into individual users to enable the delivery of help desk services e.g., when a doctor responding to emails at home complains they cannot access Outlook and so on.

Deep Insight into Business Transactions

Business transaction monitoring (BTM) is the approach commonly used by APM tools to identify and diagnose server-side processing slowness in websites, eCommerce sites and web applications. A transaction is a user-instigated action with a desired outcome. In the context of healthcare this could be a patient booking an appointment or an employee requesting annual leave within an HR app. Thresholds and Key Performance Indicators (KPIs) can be associated with transactions, especially around response times; for example, the annual leave request should take less than 2 seconds to process.

Using bytecode instrumentation and tag-and-follow techniques, business transaction tracing highlights the time spent at each of the application tiers by following each request as it is processed through the application front end, middleware, and back end.

Using this information, IT operations teams and web application managers can identify problems such as:

- ➔ Badly designed business logic in the application code that can take up excessive time to process
- ➔ Poorly written database queries that require a lot of time to execute
- ➔ Web service calls to third-party, external components that are taking time

Business transaction tracing is one of the critical dimensions of APM. Without requiring any application code changes, business transaction tracing provides insights that help IT operations staff identify where the problems lie. Web developers can determine which portion of their Java or .NET code needs optimization. They can also analyze to see which queries need to be tuned for faster response times (for example, by making better use of database table indexes). A good APM product facilitates a common language between IT administrators and application developers, focusing on the transaction and outcome for users rather than on code modules and function calls.

Many healthcare customers use eG Enterprise to apply transaction monitoring and analysis.

Real-world improvements delivered by eG Enterprise include:

- ➔ **Reduced Transaction Time:** One single activity by a doctor within Nexus (Java) was taking 16 seconds to complete a transaction, eG Enterprise was able to provide the hospital IT team with data showing why, which when supplied to the application vendor, resulted in code changes reducing the activity to 0.11 seconds.
- ➔ **Resolved Long-standing Issues:** A healthcare provider discovered through their use of eG Enterprise that the Java Garbage Collector was not completing larger jobs, slowing down certain applications. The application slowness was a known problem for 18 months but before introducing eG Enterprise, the IT team had not been able to source the issue.
- ➔ **Eliminated Performance Bottlenecks:** SQL inefficiencies and deficiencies leading to unnecessary performance bottlenecks were identified. SQL query and code-level diagnostic data from eG Enterprise allowed IT and VDI administrators to prove to application teams and suppliers that improvements were needed.

In the context of potentially millions of user transactions from staff and patients, the automation and scaling capabilities of any APM tool need careful evaluation. It is impractical for administrators to manually define and refine alerting thresholds, especially considering seasonality and chronological user patterns. Application usage patterns are often quite different on a busy weekday morning compared to 3am on a Sunday. This is where eG Enterprise's patented AIOps (Artificial Intelligence for IT

Operations) capabilities, built around machine learning technologies, exceed the capabilities of many other APM tools. Capable of processing and correlating millions of data points from metrics, events, logs, and traces, eG Enterprise intelligently learns about your applications and auto-baselines performance, dynamically adjusting out-of-the-box pre-set alert thresholds. Intelligent AIOps capabilities will proactively detect anomalies and automatically raise alerts when application performance shows signs of slowing.

04

Converged Application and Infrastructure Monitoring

BTM features alone are insufficient in the modern healthcare IT landscape. While real user experience and transaction monitoring will identify which tier a problem causing slowdowns and issues lies in, they do not identify the true root cause, which could be a full storage disk supporting a database, a faulty network switch, or a remote administrator's Internet Service Provider (ISP) or Wi-Fi router.

Most APM tools offer user experience monitoring and transaction tracing capabilities. However, when there is infrastructure slowness affecting the application, these APM tools cannot always pinpoint the root cause of problems. This is where unified infrastructure monitoring comes in.

To be able to truly diagnose the root cause of application slowness, IT operations teams need:

- Visibility into the availability, performance, and usage of every tier of the infrastructure – virtualization, cloud (Microsoft Azure, Amazon AWS), storage, networking, Active Directory, databases etc.
- Analysis of metrics from each tier to be able to proactively identify performance abnormalities.
- Correlation of metrics across the different tiers, to determine the exact cause of slowness.

Some examples of infrastructure problems that can affect application performance include:

- Network connectivity issues.
- Failure in a SAN array slowing down all I/O accesses.
- Backup jobs running on a database server, causing slowness for all applications.
- Resource contention at the virtualization tier, affecting applications hosted on a virtual infrastructure.
- Database-specific problems such as index fragmentation, redo log contention, etc.
- Problems on users' endpoints.

IT organizations should consider using application performance monitoring tools that provide converged performance visibility of applications and the infrastructure. Without forcing you to toggle between separate management consoles for each part of the infrastructure, your APM tool should provide correlated visibility across user experience, business transactions, applications, databases, and the supporting infrastructure tiers such as network, storage, virtualization, cloud, containers, etc. This is true "full-stack" application performance monitoring.

To summarize, business transaction monitoring is a key piece of the APM framework, but it is not the solution in and of itself for root cause diagnosis and problem resolution. IT teams need deeper, far-reaching, infrastructure-wide correlated visibility for accurate problem diagnosis and faster resolution to effectively support today's digital business.

Synthetic Testing and Monitoring

Patient and staff satisfaction or productivity are the ultimate measures of application performance. By continuously monitoring the end-user experience, IT managers can be alerted to times when users experience deficient performance, slowdowns, or outages.

Many modern applications have built-in instrumentation to track and report key performance metrics which combined with business transaction and real user monitoring, detect and analyze real problems users are encountering. This passive monitoring approach alone is not effective when users are not actively using the applications or when instrumentation is not available (for example, legacy applications and custom applications). Therefore, a synthetic monitoring approach is needed to actively and continuously test business transactions and preemptively identify problems.

eG Enterprise includes a full suite of synthetic monitoring tools that enable administrators to continually and automatically probe and test their application delivery. In healthcare settings it is common for our customers to simulate healthcare professionals accessing records early in the morning before the main rush when routine clinics start. If problems are discovered they can usually be resolved before patients or staff are impacted and care delivery disrupted.

Synthetic testing is also leveraged when IT or software changes are made to ensure that applications and services are available and performant before they go live and into production.

Cost-Effective Licensing

eG Enterprise licenses are transferable between over 500+ technologies, allowing administrators to avoid shelf ware and reallocate licenses to reflect the demands of changing healthcare practices. eG Enterprise can be licensed by server, users, or concurrent users as appropriate.

Many APM solutions are prohibitively expensive for healthcare as they are licensed by JVM instances – so if you had 5 JVMs on a system, you would need 5 licenses. eG Enterprise is licensed by operating systems monitored, not by number of JVMs to be monitored. This makes our solution highly cost-competitive in a healthcare setting where there is a responsibility to ensure costs are minimized and expenditure is focused on patient services and outcomes. The cost-effective price point allows administrators to cover more applications rather than prioritizing a few key services above others.

Secure and Scalable

As a solution eG Enterprise is designed to scale securely for even the largest multi-site healthcare organizations and the volumes and surges in demands their applications need to handle. When choosing any APM solution for larger organizations, the evaluation process should consider features that ensure observability at scale:

- ➔ **Scalability:** The APM solution should have the ability to handle high volumes of data and traffic (it's common for patients to try to book appointments first thing in the morning, resulting in traffic spikes).
- ➔ **Alerting and Notifications:** Out-of-the-box, configurable alerts and notifications for specific events, such as performance threshold breaches or errors, enable quick respond to issues. AIOps-powered anomaly detection and event correlation technologies will avoid alert storms.
- ➔ **Customizable and One-click Dashboards:** The ability to customize dashboards and reports to fit the specific needs of your organization is crucial. In larger organizations ensuring that simple rapid overviews are available is essential for scalability.
- ➔ **Integrations with Other Tools:** DevOps tools, ITSM ticket and help desk tools such as PagerDuty, Autotask, ServiceNow etc. should be seamlessly integrated to ensure that automation and workflows handle issues by process at scale.

- ➔ **Multi-cloud support:** The ability to monitor applications and infrastructure across multiple cloud platforms, such as Amazon AWS and Microsoft Azure.
- ➔ **Security features:** 2FA / MFA, encryption, user and administrator audit trail features and so on should be standard features in enterprise grade solutions.

Summary

Proactively managing the performance and availability of key applications such as Epic, Cerner, Meditech, Veradigm, Chipsoft HiX and Nexus within healthcare environments is a strategic choice that leads to long-term efficiencies, improved patient and staff satisfaction, and better clinical outcomes. Healthcare organizations that can modernize and digitize have a competitive advantage to attract the best staff and researchers. When evaluating APM tools remember to check for:

- ➔ Artificial Intelligence for Operations Capabilities
- ➔ Real User Monitoring Capabilities
- ➔ Deep Business Transaction Monitoring
- ➔ Synthetic Monitoring and Testing Capabilities
- ➔ Converged Application and Infrastructure Monitoring
- ➔ Healthcare-Friendly Licensing
- ➔ Secure Scalability

Read more about eG Enterprise for healthcare

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About eG Innovations

eG Innovations is dedicated to helping businesses across the globe transform IT service delivery into a competitive advantage and a center for productivity, growth and profit. Many of the world's largest businesses use eG Enterprise to enhance IT service performance, increase operational efficiency, ensure IT effectiveness and deliver on the ROI promise of transformational IT investments across physical, virtual and cloud environments.

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