



How **GenAI** can improve
quality assurance processes
for Healthcare solutions?

Introduction

In healthcare, medical software and applications are fundamental for managing and facilitating daily interactions and administrative duties for an ecosystem of patients, medical professionals, and health executives. With digital health being the new norm, the market for medical software is only expected to grow ^[1] – making Quality Assurance (QA) integral for ensuring the reliability, functionality, and quality of these platforms.

There's scope for innovating how enterprises approach QA across the Software Testing Life Cycle (STLC) by leveraging emerging technologies like Generative AI (GenAI). The ultimate objective is to save time, money, and effort while achieving accuracy, improving patient-centricity, speeding time to market, and ensuring compliance adherence.

IDC's bold prediction for the APEJ region indicates that by 2028, GenAI tools will be expected to write a whopping 70% of software tests. This can potentially revolutionize the testing landscape, not just by automating tasks but also by significantly improving test coverage, software usability, and even code quality.^[2]



Generative AI possibilities for QA

Software testing accounts for 50–60% of the total cost of software development including data verification, functional testing, automated verification, and others.^[3] GenAI can help improve the QA process and reduce the overall cost by managing resources efficiently, finding patterns, spotting unusual activity, and predicting potential problems.

Compared to the traditional testing process, GenAI's cognitive approach facilitates predictive analysis, empowering developers and QA teams to enact preventative measures and enhance the software's overall quality.

Following are some areas where GenAI helps drive better outcomes.

Synthetic data generation (SDG)

GenAI equips QA teams to create diverse, representative datasets resembling real-world scenarios for unbiased testing and zero ethical dilemmas associated with real patient data. Using synthetic data for software quality assurance has multiple applications, such as generating diverse test cases to assess the software's behavior, performance, and resilience to deviations. This proactive approach helps detect deviations before they become more significant problems in the early testing phases.

It also fosters a culture of continuous innovation by enabling continuous testing, especially when real-time data is required. Incidentally, Gartner predicts that 60% of AI data^[4] in 2024 will be synthetic, aimed at simulating reality or projecting future scenarios.



Scenario exploration

QA teams can explore a broad spectrum of potential scenarios with GenAI. They can uncover edge cases and rare clinical situations that might have been overlooked during manual testing with fixed datasets. GenAI can also create complex scenarios that mimic real-world usage patterns, helping QA teams evaluate how the software responds to different user inputs and system states.

Additionally, GenAI can intelligently prioritize scenarios based on factors such as criticality, frequency of occurrence, or impact on the system. This helps QA teams focus on exploring high-priority scenarios first, ensuring thorough testing of the software's most important features.

Continuous monitoring and analysis

While traditional AI relies on defined rules and human-programmed instructions, GenAI is more dynamic. In addition to creating test cases based on evolving requirements, it allows continuous monitoring and analysis to detect anomalies and potential bugs in the software automatically.

GenAI establishes a continuous feedback loop, learning from the results of previous tests and interactions to adjust its testing strategies accordingly. This self-learning capability improves its adaptability over time as it becomes more efficient in detecting vulnerabilities and areas for improvement in the software.

Complex system testing

GenAI excels at simulating real-world scenarios and exploring edge cases for complex testing. The software interacts with various components, systems, and environments during simulation-based tests, including complex user workflows, third-party integrations, network conditions, and data interactions. This simulation flags potential issues that may arise in production environments in real-time.

Moreover, GenAI explores these edge cases by generating test scenarios with extreme data inputs, rare user behaviors, or unexpected system failures, uncovering hidden bugs or vulnerabilities. It also tests dependencies and integrations, simulating API calls, database transactions, and communication protocols to verify reliability and compatibility with external systems.

Additionally, GenAI conducts performance and scalability testing by simulating heavy loads and concurrent user activities, stressing system resources, and identifying performance bottlenecks or scalability issues.



Real-life applications of GenAI in Healthcare software testing

Implementing GenAI into the STLC can revolutionize healthcare software testing across all user touchpoints, be it in Device and MedTech software, Payer and Provider applications, or Life Sciences workflows.

Figure 1 shares a comprehensive overview of GenAI applications across healthcare software testing.

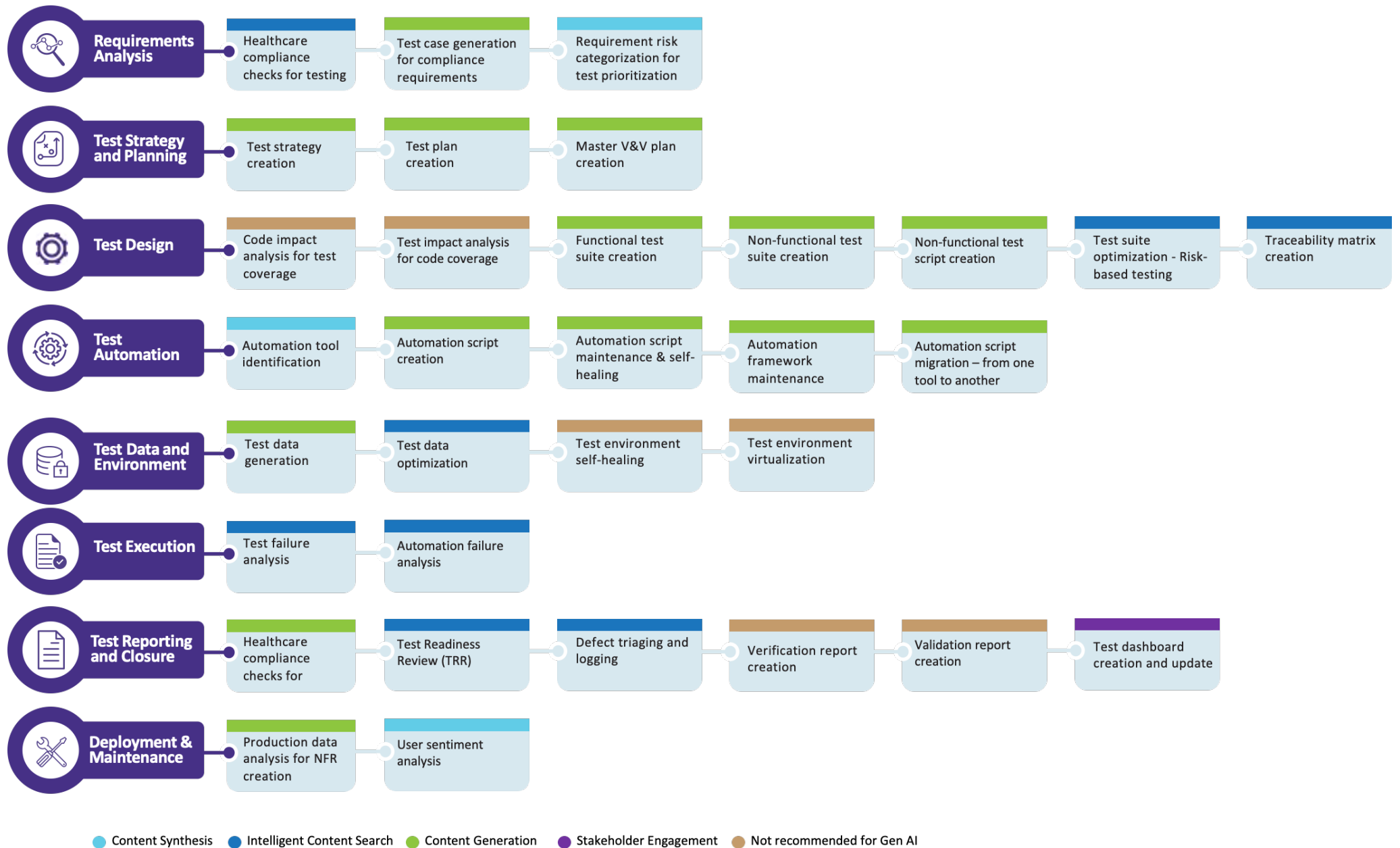


Figure 1: Overview of GenAI implementation in healthcare software testing life cycle

CitiusTech's approach to QA solution leveraging GenAI

Let's consider the following scenario where QA team needs to perform the verification on the cardiology workflow.

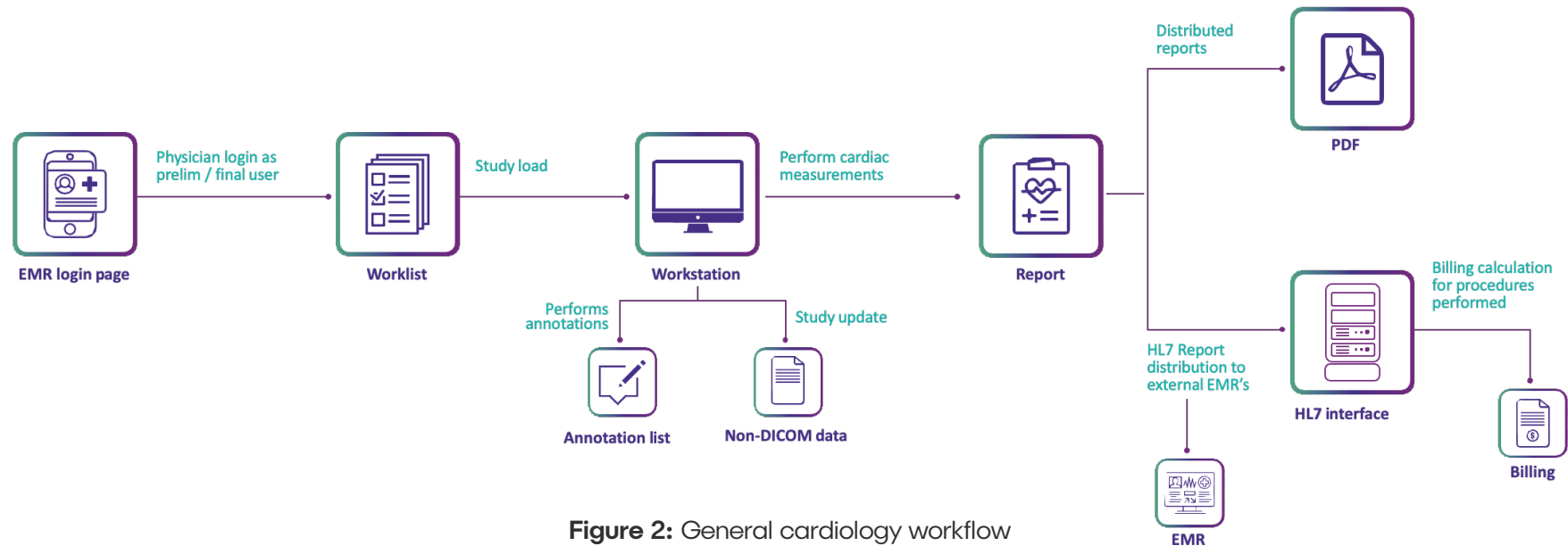


Figure 2: General cardiology workflow

A general cardiology workflow is depicted in figure 2. A resident/fellow/referring physician/radiologist, who specializes in cardiology, accesses the worklist through the EMR login page and identifies the priority cases to be addressed. Once a patient's case study from the worklist is selected, the relevant images and reports will be displayed on the workstation, where the physician/radiologist can analyze the images and perform annotations. In the meantime, updates can be reconciled to the loaded study in the form of non-DICOM information such as ECG. Cardiology measurements are performed by the healthcare professional, and a consolidated pdf report can be generated. This report can be distributed for billing and further study purposes.

To verify the cardiology workflow, the QA professional will require to generate test scenarios, test cases, relevant test data, automated test cases and execute them.

As illustrated in figure 3 below, GenAI can be leveraged to identify the test cases, generate synthetic data, and automate the test cases. Let's take a closer look to understand the use cases of GenAI in QA, with reference to, a cardiology workflow and how it can be implemented.

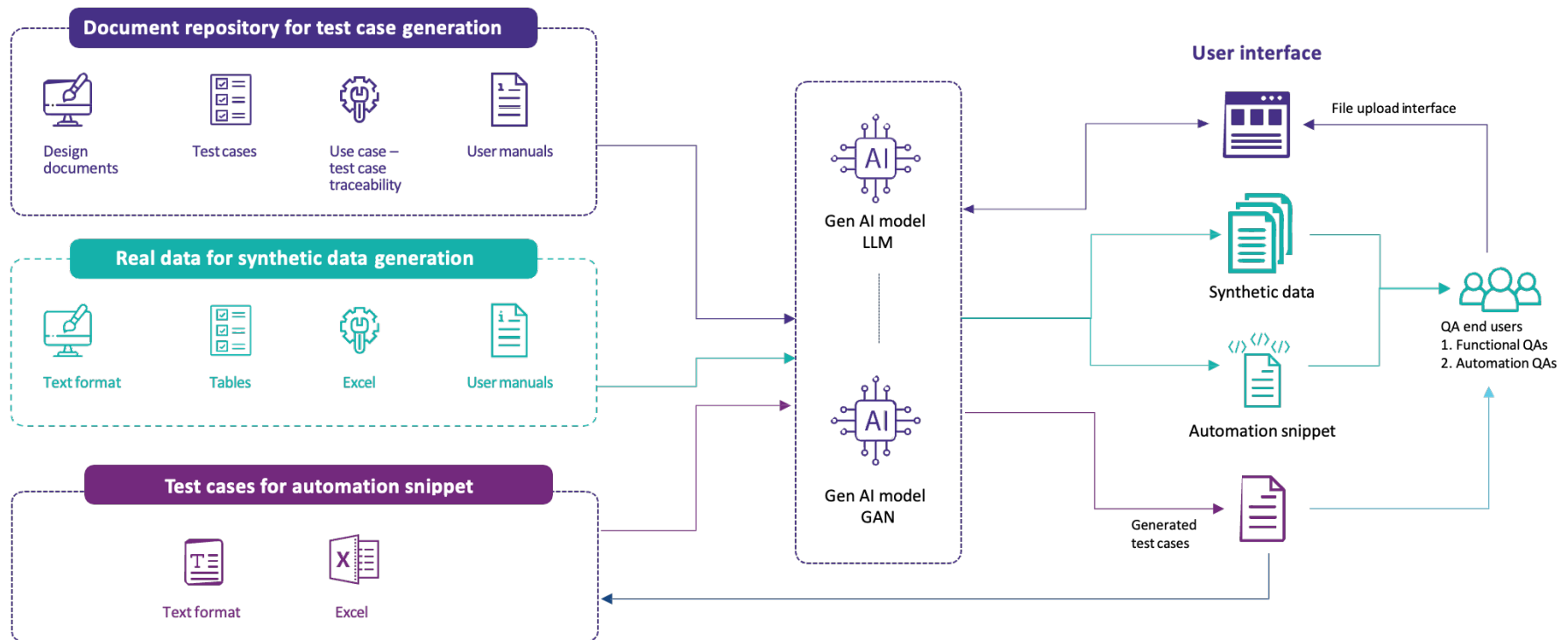


Figure 3: CitiusTech's GenAI testing solution workflow



Test case generation

As illustrated in figure 3, GenAI can readily analyze data across user touchpoints (highlighted in the cardiology workflow) using the 'Document Repository for Test Case Generation'. For instance, GenAI can consume traceability matrix, design documents, business requirement documents (BRD), user manuals etc., to generate test cases related to study loading scenarios, cardiology measurements, and workflow completion in standard format.



Synthetic data generation

GenAI could generate synthetic test data by mimicking the available data in text, excel or data base format. For instance, it can help with study load testing or cardiology measurements by generating synthetic patient data and continuing with the cardiology workflow verification.



Generating test cases for QA automation snippet generation

The test cases generated using GenAI model can be used to train the model again and generate the automation script. This automation snippet helps QA teams to execute the process faster.

The user interface in the framework allows easy access to generated test cases and automated snippets. Thus, GenAI opens a plethora of possibilities in QA across healthcare workflows, from reducing data dependency to improving processes. With test cases, synthetic data generation, and automated execution, QA team can save manual efforts and time. However, enterprises must approach with caution to ensure security and compliance is maintained.

The first step of GenAI in the QA journey: Overcoming patient safety and privacy challenges

Before implementing GenAI for healthcare software QA, it's important to scrutinize potential patient safety and privacy challenges. Here's how careful consideration can mitigate these concerns responsibly:

- **Ensuring transparency and explainability:**

Healthcare enterprises can ensure GenAI-generated test scenarios are transparent and understandable. This can be realized by explaining the rationale behind each test case and allowing human testers to assess its purpose and potential impact.

- **Protecting patient data:**

To safeguard patient data, organizations can utilize privacy-preserving techniques for generating diverse test data. QA teams can implement privacy and security measures in the design phase, ensuring that patient data is anonymized, and synthetic data adheres to privacy regulations.

- **Mitigating bias:**

To tackle AI bias, QA team must continuously monitor and address potential biases in AI algorithms used for test generation by employing diverse training datasets to represent the full spectrum of patients and healthcare scenarios. They can also utilize fairness metrics to evaluate and mitigate bias in generated test cases, ensuring unbiased test coverage.



- **Maintaining optimal test coverage:**

To enhance test coverage, QA teams must regularly evaluate GenAI-generated test suites and supplement them with human-designed test cases to ensure comprehensive coverage. Deploying a blend of GenAI-generated and human-designed test cases helps leverage both approaches' strengths for optimal test coverage.

- **Enacting re-testing practices:**

For agile application release, QA professionals must reimagine proactive regression testing to minimize time and resources for training. This can be followed by implementing robust change impact analysis to identify areas of the software that require regression testing after code changes. The approach helps focus testing efforts on relevant sections and minimizes unnecessary testing. QA teams can also apply AI-powered prioritization techniques to prioritize regression testing efforts based on the potential impact of changes on critical functionalities, ensuring efficient resource usage.



Conclusion

The soaring medical software development market – accounting for \$579.4 billion in revenue in 2023^[5] – underscores the criticality of high-quality healthcare software. This reflects the need for full-proof quality assurance in healthcare and the potential of GenAI in transforming the QA process. However, enterprises need to approach this with caution.

Embracing GenAI should be about augmenting quality assurance rather than replacing manual testing. Enterprises can make the process more proactive and agile by infusing human judgment and critical thinking into GenAI-governed quality assurance. This is achievable across three stages: understanding their vision and scope for deploying GenAI, upskilling QA teams, and creating a customized strategy for their workflows.

CitiusTech specializes in combining human expertise with GenAI to future-proof healthcare software. We draw from our deep domain expertise to responsibly transform quality assurance tailored to healthcare workflow. We focus on delivering reliable, secure, and high-quality healthcare solutions that benefit patients, and the entire healthcare ecosystem.

It's time to embrace the next in healthcare software testing with GenAI.

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