The Relevance of Middleware in Digital Health:

A Deep Dive into Its Capabilities in Modern Healthcare Technology

Middleware has long been an asset in healthcare IT. Its continued impact has the opportunity to change the future of healthcare. Many consider middleware to be the "glue" that allows different software programs to work together, enabling interoperability. Middleware helps users solve the challenges of heterogeneity and distribution, sitting above operating systems and networking software but below specific applications.

Third-Generation Middleware

The third-generation of middleware has evolved since its first and second applications, as it is now being designed to address specific environments. The objective of this environment is to offer generic services in one specific domain by grouping domain-specific tasks and data common to all applications in the middleware layer.

This is different than previous generations because it seeks to identify and isolate high-level, domain-specific tasks, delivering a better level of portability. New developments in the field reflect just this. It's more than simply the exchange of data. Third-generation middleware also focuses on reusing applications. For example, consider the Health Level Seven group (HL-7) or the SYNAPSES project. This newest generation of middleware is helping healthcare IT in several different areas. Let's explore these.

Bridging the Gap Between New and Legacy Systemsthe Community

Building an effective system architecture involves deploying tried and tested legacy systems alongside new systems that can leverage the latest advances in technology and best practice. What's more, organizations providing digital health services are frequently constrained by budgeting concerns and by limited resources, meaning that such entities are likely to retain their legacy systems for longer, even as newer and more efficient systems are rolled out.

This is not a problem in and of itself, provided that the systems can operate effectively and harmoniously together. However, interoperability issues make this difficult, which is where a Middleware solution can make all of the difference for the future of digital health.

The pooling of information within Health Information Exchanges, or HIEs, is designed to make life easier for organizations, providing effective support for interoperability between legacy and newer systems. Unfortunately, the Government Accountability Office (GAO) has identified several barriers to HIE effectiveness, including the non-standardization of information, making it difficult to provide accurate and consistent services to patients. This has IT leaders frustrated, per a Black Book Research survey, which found that 94% of payers intended to stop working with HIEs. Systems like the Fast Healthcare Interoperability Resources (FIHR) are only capable of connecting one medical facility to another. For every new facility, a new interface must be built, which is not sustainable.

Middleware offers a more viable alternative. Existing independently from other network services, middleware architecture can bridge the gap between legacy systems and their newer counterparts, with no need to rely on HIEs or FIHR, and standardizes patients data for effective communication between system architecture layers.

# Connecting Disparate Health IT Systems into One Interface

Of course, the disconnect between new and legacy systems within a health organization's architecture is not the limit of the interoperability challenges such organizations face. With the deployment of each new system, health organizations are increasing the complexity of their system architecture. This complexity needs to be carefully managed if the organization is to provide the highest levels of care and treatment to patients.

Middleware can be deployed to bring harmony to a complex and perhaps unstable set of systems. With a user interface that brings a range of different system functionalities together in one, accessible location, organizations quickly find that the efficiency of their operation is significantly enhanced.

This more holistic view of system capabilities is via Service Oriented Architecture, or SOA, which enables the extension of features and functionality from a system. This can then be applied to the user interface via a plug and play application, making broader functionality more accessible for healthcare providers. Applications can also share data across disparate systems and applications, eliminating the need for multiple manual inputs, and reducing medical errors, typically at a fraction of the overall EHR system cost.

Freedom to Innovate Beyond the Boundaries of Traditional EHR
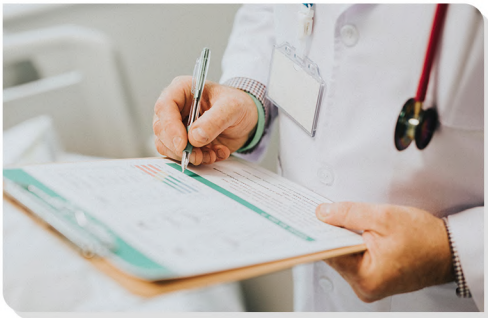
Developers in healthcare IT have been burdened with EHR infrastructure, which leads to restrictions on innovations. By deploying middleware, and by using this to connect legacy systems and to bridge the gap between disparate applications, the way is clear for developers to step away from these traditional restrictions on focus on crafting effective, forward-thinking healthcare solutions.

This untethering from the traditional boundaries of EHR enables developers to create solutions that are application-agnostic. An inefficiency is identified, a solution is developed, and this solution is integrated into the systems currently deployed by an organization. While this final stage has caused problems in the past -- and developers have been forced to grapple with just how to secure seamless integration with current systems -- the middleware interface eliminates interoperability concerns, paving the way for more effective EHRs.

The result is a set of innovative solutions that are compliant with Centers for Medicare and Medicaid Services (CMS) requirements, and agile enough to meet the needs of organizations and patients in the field. Developers are now limited only by the scope of their own vision, not by the rigid development timeline of the wider EHR.

Middleware Offers Mobile Experiences

Mobility has revolutionized healthcare, with smartphone and tablet devices now operating on the frontline of treatment and the application of medical care. However, as with any revolution, this has brought with it its own problems.

Compatibility is a minimum standard when mobile devices are deployed within system architecture. What is truly required if the needs of patients are to be met is full integration. This is a particularly pressing concern as we look to the future of digital health, as there is an urgent need to ensure that these mobile devices can access and work with data and functionality from systems that were not designed to accommodate them.

Middleware provides this agility by providing consistency and standardization across the board. The device becomes an effective access point for data, such as test results or a change in vitals, and can also update this data in real time, even across multiple systems at the same time.

Integrated Patient Portals

Patient satisfaction is important to any healthcare organization and creating a patient portal allows them to be more engaged and educated about their health. Just as middleware enables smart communication and integration between disparate systems within operational architecture, it also facilitates a secure and effective portal for patients to interact with the EHR.

These portals allow patients to review test results and communicate with their care team. To draw information from an EHR or other systems, enter middleware. Middleware can extract the information and then deliver it in a readable, usable format for the patient.

IoT Integration Saves Health IT Dollars

Monitoring patients with chronic conditions is an area in which many healthcare providers find their budgets and resources tested. This can lead to dangerous inefficiencies when it comes to patient care and treatment.

Deployment of the Internet of Things, or IoT, concepts, supported by middleware, reduces the burden placed on the budget and also secures the safety of the patient. Data collected from IoT access points can be accessed in real-time without the need for a central server. This data is then standardized and interpreted before being made accessible across a range of different mobile and desktop applications, for a unified and cost-effective approach to long-term care.
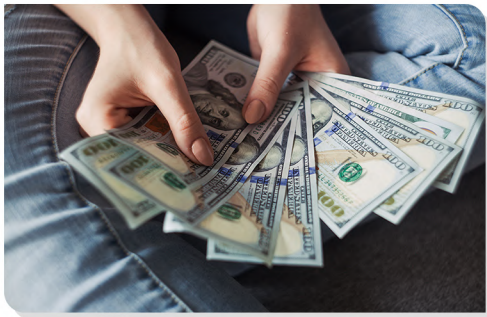
AI and Middleware

Artificial Intelligence (AI) and its capabilities are heavily influencing healthcare IT. To provide effective support to EHR infrastructure as we look ahead to the future of healthcare, AI protocols need the capability to efficiently access and interact with all available datasets. This includes retroactive integration with systems that were not designed with AI in mind.

Just as middleware achieves interoperability between systems via manually access interfaces, the same is achieved for AI functionality. Supported by the universal API, AI applications can accomplish sophisticated tasks and gain an in-depth understanding of system data. The applications of this range from the relatively straightforward, such as the automation of repetitive management tasks within the system, to the more complex -- offering tailored patient recommendations based upon medical history, for example.

Middleware can also connect AI components with blockchain-based data storage structures for more secure data management. Blockchain technology provides an immutable record of data inputs and a timeline of modifications or developments in the data. AI functionality would need the capability to access and apply this data via a secure and effective interface. Middleware provides the stepping stone required to forge these connections and accomplish labor-saving and efficiency-supporting deployment of AI.

There are many advantages to using middleware in healthcare IT. It serves as a serious solution contender for a host of issues that all come back to the accessibility of patient data for better decisions and workflows. It can extend the usefulness of EHR systems and allow organizations to retrieve more of a return on their investment. Its relevance has been and will continue to be significant in the evolution of healthcare IT.