The Path to Successful AI in Healthcare

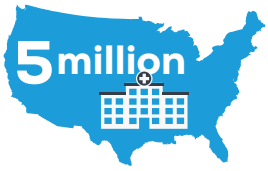
More Data, Better Data, Open Data

Introduction

Artificial intelligence (AI), machine learning (ML), predictive analytics and the Internet of things (IoT) are the buzzwords promising to change the face of healthcare. Their value and benefits are undeniable — and they are key to realizing the vision of patient-centered care.

However, before realizing the true benefits of these technologies, hospitals need to be careful to not put the information analysis cart before the data-bearing horse.

To build a successful patient-centered program, hospitals must get access to the data feeding the model and visualizations. This is especially important in critical care environments, where more than five million people are admitted in the U.S. annually and over 500,000 die every year, often without warning. To help reduce these numbers and save more lives, critical care teams need as much data about a patient as they can get, as fast as possible, along with the relevant context to take action.



AI success in acute healthcare depends on accurate, real-time data — specifically the beat-to-beat, time series waveform data of the most critically ill patients.

The burning question: What specific data do physicians, nurses and members of the care team need to expedite that intervention and build their AI models?

Creating the foundation for patient-centered care and AI

A typical patient entering acute care will often go from the ambulance to the emergency department to the operating room to the ICU to the step-down unit. During this journey, medical devices are continuously capturing mission-critical data.

That volume of data increases dramatically once these patients enter ICU environments and other critical care areas such as cardiology, neurology and neonatology. In these areas, an average patient could be connected to eight to 10 devices, generating more than 800,000 data points every hour. For many patients, the clinical decisions informed by this large volume of data could alter their outcomes.

Yet, despite these rich data collection points, much of the information is not saved or stored. When seconds count, this is a real challenge for the doctors, nurses and care teams that have to try to quickly assemble the pieces of a complex puzzle to make crucial, real-time decisions.

This critical data problem needs to be solved before we begin to realize AI's full potential. We need to focus on properly harnessing and aggregating all the data collected on a patient from these disparate devices. We need to find a way to fuse it with EMR data such as labs and medications. And we need to deliver that data fusion back to care providers in real time, within their workflows, with the visualization and content they need to take action.

This is how we can empower these high-tech healers and help them save more lives.

The question is, where do we start? What data do we need to change care and create the foundation for patient-centered AI in healthcare? How do we ensure that AI in healthcare doesn't become just another healthcare technology vision that falls short of its promise?

This white paper will take a hard look at why data is still not providing real-time decision support, despite big budgets and smart intentions — and we'll offer recommendations for what needs to happen based on three foundational data pillars. These pillars represent the fundamentals that every hospital and healthcare system should consider to fix their data problems.

1. **More data, better data**
2. **Data delivery with context**
3. **Open data with tools for transformation**

When these pillars are recognized and adopted across hospital systems, we can then create a new standard of care — and pave the way to real-time, patient-centered AI.

A System in Need of the Right High-Tech Fuel

A single approach that breaks down device barriers to open data and also offers access to multiple data tools and modeling options is key to solving data access problems.

Throughout the hospital, and particularly in ICUs and other critical care units, today's health information technology tools are desperately in need of informational fuel for their algorithmic calculations. We need an enterprise-wide approach to solving the underlying problems with the data that propels those analytics before healthcare systems can take advantage of AI, machine learning and, ultimately, patient-centered care.

Problems such as data timeliness, accuracy and accessibility are key to realizing a personalized, patient-centered approach to care. Building a foundation for the "right" AI in critical care will inform success at scale for acute care centers. Achieving these data "rights" for critical care will create a healthcare environment in which AI can thrive and patients will benefit dramatically from accurate, relevant, real-time monitoring data. In doing so, it secures those three essential data pillars for acute care.

1. More Data, Better Data

Quality in, quality out. Generating not just more data but better data has to be a top priority for the system to work. Care teams often grapple with limited, outdated or inaccurate data just in the everyday care of their patients. They struggle with trying to assemble a complete patient trend to determine the right intervention as quickly as possible. They have to jump from device to device, scrambling to find hidden data in the EMR, some of which is not recorded yet or is potentially inaccurate. And this is just with the everyday care of patients — not AI.

This cascade of inaccurate data invites incorrect interpretation, introducing risk rather than reward. Therefore, the most important step in the journey to better care for our most medically complex patients and the creation of AI is to provide all the data care teams need, *accurately* — and as fast as possible for optimal results. After all, real-time care decisions, analytics and data transformation are only as good as the information that advises their models.

Overcoming Device Deficiencies

In a perfect world, data would be harnessed, analyzed and used to drive real-time care. Patients' information would be examined to elucidate patterns that signal worrisome changes or life-threatening events. All data sources would be combined to add value to other patient data to build out a more precise, personalized picture of a patient's health. They would essentially be the wellspring of data to expedite care and intervention and feed the models for patient-centered AI.

The problem? The biomedical devices monitoring patients who are clinging to life generate some of the largest quantities of data in healthcare today. Yet these devices largely operate in isolation, disconnected from one another and the full hospital IT infrastructure.

Critical care patients are often connected to multiple devices generating thousands of samples per hour. These samples include some of the most vital and up-to-the-minute information needed to augment urgent, complex care delivery. Care teams in this intense environment struggle to access data that is siloed, often in proprietary formats, or is only sent to temporary storage. Too often, that data remains discrete, chained to the device and difficult, if not impossible, to unlock for manipulation, modeling, meaningful analysis or communication beyond the bedside. Then, it is often flushed shortly after acquisition, taking with it all of a patient's history. It is no exaggeration to say that biomedical device data is itself in need of critical care.

Over-Extending the Electronic Medical Record

Acute care teams are also frustrated by the fact that patient history and trends, as well as most ML- and AI-based predictive analytics and early warning scores, rely on the electronic medical record (EMR) as their primary data source. EMR data has achieved major breakthroughs in care and is a prerequisite for clinical summaries, data modeling, analytics and ultimately precision medicine.

The challenge is, they were never intended to manage the continuous real-time, high-fidelity time series waveform data needed for complete trend analysis and real-time AI. Rather, they were designed to store limited data types as snapshots at discrete intervals with low sampling rates to support reimbursement and general trending.

For meaningful analysis and clinical decision support, physicians and other members of the care team need better ways to augment their complex decision-making in real-time. Patient waveform data that reflects a patient's changing condition is the answer — and not just from a single cardiac monitor but from all monitoring devices connected to a patient.

Care teams need to evaluate trends in patient physiology across all connected devices, for as far back as possible. They need to be able to overlay other patient information on top of this time series data such as labs and medications to see the impact on physiology, determine the root cause, and prescribe the right intervention as fast as possible. Unfortunately, they can't do that today because the current state of single data points, over time, are often delayed, potentially inaccurate, and simply not enough.

By requiring accountability for accurate data from all stakeholders, hospital leaders demonstrate their support of evidence-based medicine and their commitment to "getting it right" the first time instead of making decisions based on faulty data.

When seconds matter, this wasted time may literally mean the difference between life and death for thousands of critically ill patients. It is not an overstatement to say that life support is also needed for data access, especially in critical care.

2. Data Delivery With Context

Complementing the need for more data and better data is the need to deliver data with context, directly to caregivers within their clinical workflow. Real-time surveillance with robust patient history is a crucial mandate in critical care. This will ensure that healers can intervene quickly to reduce risk and save lives.

With busy providers and clinicians deployed across the hospital and often beyond, the ability to unchain data from devices and push it to care teams wherever they are is paramount for improved care. The more relevant data caregivers have surrounding a device reading or event, the greater their understanding of the problem and the more appropriately they can respond.

Sounds simple, but it isn't. Today, true remote access to any real-time bedside data, including data surrounding patient events, is limited. And even if data is available, trends and relevant context are often missing.

Patient risk and similar readings are typically quantified as numbers or scores without an explanation of their significance or possible cause. Care teams need a way to access that data as far back as possible in a single view. Typically, the only devices storing data in some form are cardiac monitors. Even then, they only store the data for 72 hours or less. Critical care patients can be in the hospital for weeks or months.

Without some way to unify all individual patient data, not only from the EMR but fused with beat-by-beat waveforms from all connected devices, physicians and care teams will continue to spend more time as detectives trying to put together the pieces of a complex puzzle than caring for their patients.

The result is that care teams are often forced to return to the bedside to check readings on multiple devices and within the EMR to determine the meaning of a score or the cause of an alert, alarm or event.

Data with context — and access to that data, anytime, anywhere, beyond the bedside and walls of the hospital — is crucial to impart meaning and reduce patient risk.

3. Open Data With Tools for Transformation

The first step in the data journey is solving these challenges of harnessing already-available data — and making it available to care teams to take action. Assuming we have solved these issues, we then have the foundation needed to add AI to that data set to further reduce risk and save more lives.

The need for AI is especially urgent in complex critical care settings like cardiology, neurology and neonatolgy. In these environments patients crash fast, often without warning. In a single minute, physicians often have to process more than 300 data points to make life-saving decisions. While machines will never make those decisions for doctors, we need machines to help them process data faster. AI is the answer.

The key to AI, however, is to have a complete system that enables its deployment back into the clinical environment. Data aggregation can be accomplished, but how that data is accessed is the bigger issue that needs to be solved.

Some solutions provide integrated information across select critical care devices, but it is often locked down in other vendor-proprietary formats or may require conversion into difficult-to-manage and expensive file types such as .xcl, SQL or XML. Many of the available solutions don't provide the visualization layers that enable faster transformation. They may not provide the ability to easily fuse other data into that visualization. And they don't always provide pathways for the physicians within their clinical workflow, without having to understand complex ML tools.

All of these issues mean that timely transformations to create the real-time analytics to realize patient-centered care are a challenge and nearly impossible at scale. A single approach that breaks down device barriers to open data and also offers access to multiple data tools and modeling options is key to solving data access problems.

Open application program interfaces (APIs) and software development kits (SDKs) are essential to empowering hospitals with the control needed for fast data manipulation.

Open application program interfaces (APIs) and software development kits (SDKs) are essential to empowering hospitals with the control needed for fast data manipulation. Integration with standard tools such as Spark, Python, Java, MatLab and others for modeling and ML is critical to success.

Also key are user-friendly interface options that enable cohort management, large-scale validation and retrospective analysis. Data modeling and labeling, as well as algorithm and study management to expedite model-building and transformation at scale, is critical to success. Lastly, intuitive user interfaces that allow providers and physicians to label data within their workflow are key factors to the ML building machine and realization of the AI vision.

Anyone can do a single analytic. What we really need is a single architecture; a single time series data engine; a single platform that enables vendor-agnostic patient surveillance and the ability to develop and deploy individual hospital developed analytics, at scale.

Conclusion

To successfully implement AI in healthcare and at scale, hospitals must solve the data crisis through three crucial pillars: more data, better data; data delivery with context; and open data with tools for transformation. We must break down silos to capture every single data point, every waveform, every beat, from every device that is connected to the patient — and do it in real time.

Time series waveform data is the most basic key to effectively realize the vision of AI in clinical environments — and especially in critical care. Only when we unlock this data will healers be able to deliver precise, personalized care reflecting a patient's changing condition. This "live" data should also be time-synchronized and fused with EMR patient information. Ideally, in the future, it will be fused with other relevant information enterprise-wide and beyond, such as genomics, images, data lakes and more.

The best way for hospitals to accomplish the AI vision is a single, centralized, vendor-agnostic approach that aggregates and integrates all biomedical device data with other relevant patient data from the EMR as well as from systems across the enterprise and beyond. Hospitals should also seek solutions that provide features and tools that give them control and access to their own data so they can manipulate and analyze patient information as fast as possible. And they need to be given a way to operationalize and deploy those analytics at scale across the hospital and healthcare system.

These are the foundational elements necessary to solve the systemic data crisis in healthcare and to realize the true value of precise, patient-centered care through AI.

The information is available. Harnessing it is the challenge; leveraging it is imperative.

What's Next?

Addressing the need for data integrity is just the beginning. To implement AI at scale, other steps are needed beyond improving data. This four-part white paper series examines each of these issues in depth.

Part 2 of the series will discuss changing the way patients are monitored. Bedside biomedical devices are and will remain a requirement, especially in critical care where multiple devices are required to monitor organs in the body and/or help sustain life itself.

Unlocking these devices from the bedside to enable software-based monitoring and anytime, anywhere access is the next step in achieving transformation. We will explore these benefits in more detail in the next white paper.

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