EHR Data Integration Guide:

What's Happening, Where Should We Go, and How Do We Get There

We're closer to interoperability than you might think.
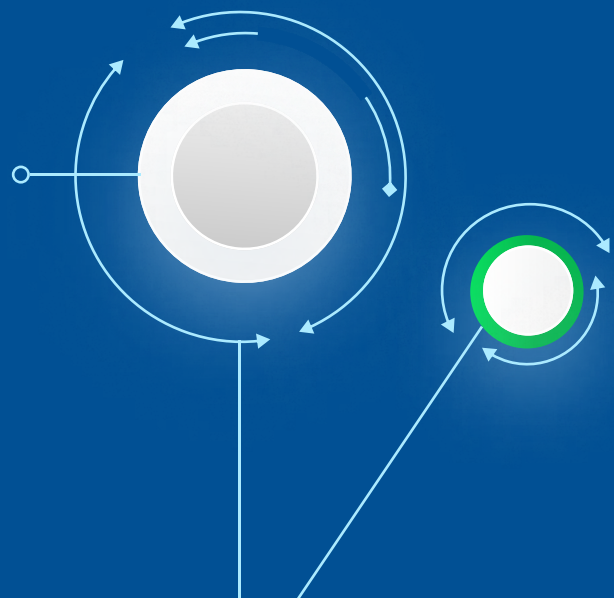
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EXECUTIVE SUMMARY

In the early 1960s, great medical and technology minds developed the first prototypes of the electronic health record (EHR). It launched the digital age of healthcare with the promise of more accurate, useful health records that would improve care and reduce errors.

Fast forward to digital healthcare today. Healthcare technology holds greater promise than ever to improve every step of the patient journey. Patients can already see health records on their phone. AI and machine learning will help discover new drugs, perform precision surgeries and process claims. And we can track and manage our health with our watches.

Investors are confident that this remarkable progress in healthcare technology will continue, funding digital health companies at record levels that continue to skyrocket.

To realize their full potential, these new and evolving technologies must be able to talk to each other and especially to the EHR systems at the center of the patient journey. Healthcare has made huge leaps forward in achieving this interoperability with better collaboration, advanced APIs, and interface standards such as HL7 and FHIR.

Healthcare still has some data integration hurdles, but now they are ones we can clear. It starts with a strong interoperability partner, intelligent strategy, and the health tech expertise to build and employ successful solutions. Smart healthcare software companies and providers have an unprecedented opportunity to achieve meaningful interoperability to improve outcomes and reduce costs more effectively than ever.

1 Healthcare Interoperability:
Where We've Been, Where We Are, and the Enormous Promise Ahead

In the 1960s, people eagerly anticipated a shiny, Jetsons-style future. Flying cars. Jet packs. Robots that clean and cook for us.

And bold healthcare visionaries dreamed of a single, accurate electronic health record shared with everyone, anywhere.

Sixty years later, we might not be flying around town yet, but we've made enormous leaps forward in capturing and exchanging health records and data. We have more consistent, reliable, accurate patient records than ever before.

And digital healthcare has reached a watershed in fulfilling its total promise. Health technology advances overflow with positive potential:

2021:
INVESTORS BULLISH ON DIGITAL HEALTH

$57.2B
Record Global Digital Health Funding

$37.9B
Record U.S.Health Digital Health Funding

"State Of Digital Health 2021 Report," CBI Insights.

- AI and machine learning that can improve diagnoses, care plans, drug development, surgeries, and more.

- Wearable watches and other internet connected health devices give patients greater ability to capture and share critical health information with doctors.

- Patients with newfound access to their own EHR health records on phone apps that share their EHR medical records. Automation of claims processing that gets smarter and smarter on its own.

- Investors are all in. An unprecedented explosion of healthcare technology innovation and investment reflects the confidence that promise will keep growing.

There is one hill to finish climbing: Interoperability.

Healthcare has been on the hunt for interoperability for decades. Sometimes in healthcare, we express frustration that we have not achieved complete interoperability yet. That frustration often overlooks our many advances in healthcare data exchange, accelerating faster than ever in the past 10 to 15 years:

- More adoption and effective use of HL7 standards

- Evolution and adoption of advanced FHIR and SMART on FHIR standards

- More collaboration among (most) vendors to move interoperability forward

- More meaningful and clearer directives from federal legislation, the Center for Medicare Services, and Health and Human Services that define more specific objectives and technologies

The question to ask is not will we get there, but how? How do we keep improving how our current healthcare systems talk to each other and share data? How can we keep advancing data integration for oncoming waves of wearables and other new healthcare technology solutions?

We will look at answers to these questions, and ways to get over a couple of key hurdles on the track to interoperability:

- Standards such as HL7 and FHIR have not standardized everything. Organizations do not always apply the standards in consistent ways. Integration technologies and data exchange methods often still vary widely, even within a single provider system.

- It's one thing to know what integration technologies and tools are available. But that does not make it easy to establish a successful interoperability strategy and implementation to meet your goals or your clients goals.

EHR Timeline

Let's take a look at where EHRs started and how interoperability has evolved, with big leaps forward in the past 12 years:

1960s

- In the early 1960s, Dr. Lawrence Weed introduced the problem-oriented medical record (POMR), which established a standard structure for medical records focused on patient problems

- Industry leaders in the early 1960s began developing the first "clinical information systems," including EHR pioneers at the Mayo Clinic, Lockheed, University of Utah, and 3M.

- According to HIMSS, by 1965 providers, technology companies, and the government managed 73 clinical information and 28 health data storage projects.

1970s

- Federal health agencies begin EHR development that will lead to significant advances and help establish numerous important EHR systems over many years.

- Lockheed and others continue to roll out new systems for hospitals that start to look more like modern EHRs

- Veterans Affairs (VA) hospitals begin adopting innovative EHR technology that would eventually become the widely adopted VistA system still in use today

1980s

- Early 1980s: EHRs become more reasonably affordable for healthcare providers, and adoption begins to expand.

- Mid-1980s: Most attempts to integrate and share data across systems involved two vendors building customer interfaces, which worked for point-to-point connections but did not advance broader interoperability.

1990s

- 1987: The Health Level 7 organization forms with a charter to define common interface standards for healthcare.

- 1988: SAIC develops the Composite Health Care System (CHCS) for military healthcare centers.

- 1991: Institute of Medicine published "The Computer-Based Patient Record," which accelerated the national discussion about EHRs.

- HL7 v2 released.

- Epic, Allscripts, NextGen and other players begin to capture market share, with other vendors following fast.

- 1996: HIPAA prompts the healthcare technology industry to enhance data privacy through stricter access control, network security layers, and better encryption.

2000s

- 2004: President George W. Bush issues an executive order creating the Office of the National Coordinator of Health Information Technology (ONC). Healthcare advisors called for nationwide implementation of EHRs by 2014.

- 2009: The Health Information Technology for Economic and Clinical Health (HITECH) Act added huge financial incentives and meaningful use mandates that accelerated the embrace of EHR adoption.

- 2009: An estimated 300 EHR vendors were advancing technology and competing for market share.

2010s

- 2010: SMART initiative begins, led by Boston Children's Hospital and Harvard Medical Center, with a mission to create apps that could work with and share data from any EHR system.

- 2012: A small HL7 team launches FHIR, a pursuit of a next-generation interface standard to accommodate more data and make development easier.

- SMART on FHIR framework released.

- Late 2010s: Most EHR vendors have adopted and created APIs using the FHIR standard. Major players led by Apple Health also committed to FHIR, rapidly advancing momentum around the standard.

2020s

- May 2020: CMS implements the final rule on interoperability to expand patient access and specify how much data EHRs must share. The net result by 2022: **Providers and payers (and by extension their technology vendors) must comply with assertive deadlines to adopt FHIR and SMART on FHIR.**

Key sources:

https://www.beckershospitalreview.com/healthcare-information-technology/a-history-of-ehrs-10-things-to-know.html

http://www.sarasotafootcarecenter.com/contents/electronic-medical-records

https://www.mgma.com/MGMA/media/files/fellowship%20papers/The-Evolution-of-the-EHR-in-Medical-Practice-FINAL.pdf?ext=.pdf

2 Healthcare's Current Objectives for EHR Integration and Data Sharing

We've taken a quick look at how we got here. What are the interoperability objectives for healthcare today? Several things motivate and guide hospitals, systems, technology companies, and other care providers regarding EHR interoperability:

- ✓ Comply with government and agency laws and rules

- ✓ Meet customer wants and demands

- ✓ Prepare for waves of new data from wearables and the Internet of Medical Things (IoMT)

- ✓ Establish productive partnerships that expand market opportunities

- ✓ Achieve the highest defined levels of integration success

- ✓ Sometimes, to make healthcare better and more accessible

Laws and Rules: We've seen a long evolution from early EHR development to recognizing the need for interoperability to seeing laws with enough teeth to make it happen. Over time government mandates have also become more technology-specific, leading to the final rules of the Cares Act specifically mandating that payers and other organizations adopt specific FHIR-based interfaces to talk to each other and share data directly with patients.

Consumer and Provider Demands: People today shop for healthcare like they shop for cars or shoes. What's the best treatment? Which doctors and providers have a strong reputation? How much will it cost?

This new world of empowered consumerism in healthcare demands more patient access to their health records and control over their health journey. They expect providers to let them easily schedule their appointments online, get updated test results and care information, and manage accurate claims and payments.

Without interoperability among all clinical, administrative, and financial systems, this vision fails. If the patients' front door is locked, hard to open, or only lets you squeeze through a narrow opening, consumers will find a better option.

Healthcare software vendors face similarly elevated expectations. If you're delivering software hospitals and doctors depend on to deliver care and operate effectively, you must provide the connections to share data with their other systems, partners, and patients.

Wearables and IoMT: An important extension of consumerism: Wearable and other connected healthcare devices. Medical wearable devices have become much more sophisticated, affordable, and accessible, connecting people to healthier lives in ways we only dreamed of even five years ago.

Your watch, armband, or home monitor can collect accurate data for blood pressure, heart rate, glucose levels, EKGs, health activities, and more—and share that data with your doctor. Doctors and patients can collaborate to anticipate health events and adjust treatment courses based on live data.

But this huge new influx of valuable medical data also must integrate with EHRs and other healthcare systems. This will continue in healthcare, as we find more new ways to capture patient data that create additional needs for interoperability. AI and machine learning, as well as FHIR and SMART on FHIR, will help make meaning of and successfully integrate this data.

Building Population Health Partnerships and Networks: Providers increasingly collaborate with ACOs and extended healthcare networks to ensure that people get value-based care and the best experience at every stage of the patient journey. Population health goals also link the healthcare provider communities closer than ever. Some EHR vendors have taken note. Cerner, for example, offers FHIR-based, RESTful APIs to connect with its HealthIntent population health platform.

Meeting Industry Benchmarks: Whenever a new technology option emerges, organizations step in to define the best practices and measures for how to **do it as well as it can be done.** The Healthcare Information and Management System Society (HIMSS) has set this bar for data exchange, outlining the four levels of interoperability:

- **Level 1 – Foundational:** Foundational interoperability connects HIT systems for secure data exchange.

- **Level 2 – Structural:** Structural interoperability defines the format, structure, and syntax of data exchange. This allows healthcare information to move between systems without losing its clinical or operational meaning.

- **Level 3 – Semantic:** Semantic interoperability combines standardized data structures, value sets, and vocabulary to interpret data more easily. This improves healthcare quality, safety, and efficiency.

- **Level 4 – Organizational:** Organizational interoperability facilitates secure and timely data sharing through governance, policy, and organizational regulations.

Technology advances the first three levels, while process and governance define the organizational level of interoperability. Healthcare technology companies and providers seek to advance to the highest levels the industry has defined.

Improving Healthcare: It's easy to forget just why healthcare began this complex, winding, continuing, decades-long journey to interoperability: Better care outcomes for patients. Yet we still see current articles like these telling us about the promise for interoperability to improve healthcare in the future.

Health Level 7 International (HL7) emerged in 1987 as a guiding light and influence for advancing healthcare interoperability with the mission to improve healthcare delivery and patient outcomes. Many providers and technology companies remain passionate about this promise of connecting accurate, updated patient and health data for every stakeholder in the patient journey.

But differing incentives and motivations among EHR vendors continue to complicate and sometimes slow the journey.

ARE EHR VENDORS HELPING OR STALLING INTEROPERABILITY?

That's no criticism, just a pragmatic observation. EHR vendors have had a guaranteed market. Hospitals, systems, providers, and payers all have faced requirements to adopt electronic health records in incrementally more meaningful and substantive ways. Providers partnered and invested huge amounts of money with the vendors that they felt could best meet their needs and compliance targets, as quickly as possible.

Many pioneering and assertive EHR vendors have done quite well-EPIC, Cerner, Allscripts, eClinicalWorks, and other big players. They have also advanced technology innovation in ways that healthcare had not seen before. Healthcare organizations use EHR systems to capture more complete and accurate records of patient conditions, history, meds, treatments, labs, financial data, and more. It takes effort, and doctors still don't love it, but it's far better than the pen scribbles that populated paper records in file cabinets for decades before.

EHR Vendor	Integration Offerings	On FHIR?	Other interoperability alliances?	Additional Thoughts
Epic	Several ways to connect: EpicCare Link and Community Connect let providers either see or use another provider's EPIC EHRs. Share Everywhere (part of MyChart) lets authorized patients see and share their EPIC records online.	✓	CareQuality	Most integration offerings focus on extending access through EPIC systems, not necessarily sharing with other vendors.
Cerner	Ignite FHIR-based APIs for that hook into their Millennium EHR and HealthIntent population health platform	✓	CareQuality CommonWell	Cerner expresses a broad vision and commitment to interoperability and seems to offer broad access to its data in many ways

EHR Vendor	Integration Offerings	On FHIR?	Other interoperability alliances?	Additional Thoughts
Allscripts	dbMotion promises single patient record that works across all EHRs and systems. EHR platform TouchWorks for ambulatory care leads with interoperability.	✓	CareQuality	Some in the industry recognize Allscripts as the interoperability leader among EHRs. It's clearly part of the fabric of their mission and solution development.
athena health	They talk about it, but don't share clear options for interoperability.	Partially	CareQuality CommonWell	athenahealth primarily serves physician practices and approaches interoperability from the lens of their customer base, which differs from other EHRs
MEDITECH	Traverse interoperability solution to connect with their HER, and newer Greenfield API dev environment.	✓	CommonWell	MEDITECH seems to be making efforts to expand its integration options and open more data access.
nextgen	NextGen Connected Health Solutions and patient-focused APIs.	✓ Patient-access focused APIs.	CareQuality	This smaller player has built integration strategy on participation in CareQuality and patient access APIs.
eClinicalWorks	Offers the PRISMA health search engine to search records from CareQuality, and CommonWell networks.	Direct FHIR services not part of strategy.	CareQuality CommonWell	A novel approach to health record access. Not really inoperability with its systems, but a valuable and unique offering.

EHR vendors built systems using their preferred languages and data models. They were scrambling to capture market share, not establish compatibility and exchange data. As adoption grew, the healthcare industry recognized that EHRs would only truly work if the systems and technologies could talk and share data with each other.

But consider this. EPIC owns one-third of the U.S. EHR market. EPIC and Cerner together dominate with 57 percent of the EHR market. Add in MEDITECH and three vendors control 72 percent of the EHR market.

For a dominant healthcare technology vendor, interoperability can seem a threat as much as an opportunity. If you have one-third of a multibillion-dollar market, why give competitors access to your solution? We are not taking sides but acknowledging that the motivations of the biggest, most influential vendors can curve the path to interoperability.

3 The Path Forward

Healthcare experts and observers are quick to point out where interoperability has fallen short. But important things take time, and we suggest with the right mix of strategies and tools providers and technology companies can advance interoperability more meaningfully than ever today.

The Advances of HL7

Interoperability was a chaotic landscape as EHR adoption expanded in the late 1970s and through the 1980s. EHR systems did not understand each other, and often had limited motivation to do so. Vendors built hundreds of custom system-to-system interfaces, with no single, common standard that defined the data sets, technologies, and API structure for health data exchange.

Health Level 7 (HL7) changed this game in 1987. HL7 emerged as the first major standard for healthcare data exchange designed to control the integration chaos. HL7 and its various releases have led healthcare forward in big steps to let different EHRs and health systems share data with a common interface standard.

But we can interpret "common" in different ways. HL7 has released many versions of its standards, with add-on levels of standards for specific data interface scenarios. Let's look at what HL7 identifies as its primary, most commonly used standards:

- HL7 Version 2 Product Suite

- HL7 Version 3 Product Suite

- FHIR® Release 4

- C-CDA

- CDA® Release 2

- HL7 Context Management Specification (CCOW), Version 1.6

Six primary integration standards seem manageable to assess and apply, right? But of course, there's more.

Among these standards, HL7 v2 has been the most successful, leading in adoption with 95 percent of U.S. healthcare organizations. HL7 v3 had promise but frustrated healthcare providers and software companies because it was complex and not easy to build on HL7 v2. FHIR (more to come about this) gained fast momentum and adoption and leapfrogged over HL7 v3.

Beyond these primary standards, HL7 has published hundreds of additional standards and documents, including 26 specific to EHRs, 79 clinical document architecture and markup standards, and a product grid with 366 associated standards. These often cover things as specific as interpreting different country languages, accommodating dental data elements, and handling data sets unique to the Centers for Disease Control (CDC). This expanded collection of protocols and documentation highlights just how difficult it is to define a single data exchange standard in healthcare.

HL7 standards, widely adopted today, marched a generation of healthcare data integration forward while also adding new elements of complexity for interoperability.

FHIR Starts to Accelerate EHR Integration

Even with tremendous progress, earlier versions of HL7 had limitations. Today's developers face a steep learning curve with older socket-based, SOAP, and XML protocols. Many HL7 standards exist and many providers have adopted many variations. And mapping numerous single data elements can make it tougher for other systems to understand and use the data, and make development more complex.

HL7 also only works with structured data. Think of a database with discrete, specific fields for things like patient name, lab result, prescription name and quantity, and insurance and financial information.

Unstructured data (scanned images, handwritten doctor notes, PDF files) comprise 80 percent of all healthcare data. Meaningful interoperability must include it.

After the lukewarm adoption of HL7 v3, the breakthrough FHIR standard emerged from the HL7 technology teams. First released in 2014, FHIR became the next-generation HL7 data exchange standard. Some key capabilities that FHIR advanced from previous HL7 releases:

- **Unstructured Data Exchange:** The FHIR standard accommodates structured and unstructured data. This solves a critical interoperability challenge and eliminates much tedious manual input and communications. It opens doors wide for exchange of more and more health data.

- **Faster and Easier Interfaces:** The FHIR standard embraces more modern API technology, including the RESTful protocol and a choice of JSON, XML, or RDF for representing data. Developers more comfortable with these advanced tools can learn, develop, and implement more useful FHIR-based interfaces faster.

- **"Resources" for Better, More Intuitive Data Exchange:** FHIR introduced the concept of "resources" to healthcare APIs. Resources represent common healthcare concepts and components, such as patients, lab results, insurance claims, and appointments. The FHIR standard identifies 145 resources, making interfaces more flexible, development more intuitive, and data more useful for other systems.

FHIR adoption has lagged a bit behind expectations, but healthcare leaders project rapid deployment moving forward.

There's an App for That: SMART on FHIR
SMART (Substitutable Medical Applications and Reusable Technologies) launched in 2010, led by Boston Children's Hospital and Harvard Medical School. The premise: Let healthcare IT technology developers build single apps that work with any health information system. Providers and patients could then choose the apps that best fit their needs and not be locked into apps that only connected with one or another: EHRs or health data systems.

When FHIR started in 2012 and quickly gained momentum, the brains behind SMART saw an opportunity to advance their vision of interchangeable health apps faster and more successfully. It's a promising marriage: FHIR defines the structure and format for EHR data; SMART defines how third-party apps will work with EHRs, which specific users are connected, and what patient data they are retrieving.

The SMART mission shifted to focus on how FHIR could power SMART apps.

SMART also introduced an elegant way to make data available to apps without moving the actual data. For example, an API hooked into an EHR system gives other systems the ability to connect and transfer the data for system A to system B. SMART on FHIR lets system B see and use the data from system A without having to transfer and translate the data from one system to another.

(Other web services in health provide a similar way to show data in another system without having to actually transfer that data between systems.)

SMART on FHIR apps let providers, payers, and patients view patient records, monitor cardiovascular health, schedule services, and much more. They can pull in all the data they need from almost any EHR system, whether it's Epic, Cerner, AllScripts, athenahealth, or another vendor.

It also establishes protocols for client authentication and authorization to connect to FHIR servers.

As with FHIR, the 21st Century Cures Act and Centers for Medicare Services rules mandate SMART adoption for many healthcare organizations. FHIR and SMART on FHIR will be a big, lasting part of healthcare's interoperability future.

EDI and Flat Files

Electronic Data Interchange (EDI) and flat files have been around for a long time. While there are no big advances in these technologies and data formats, healthcare organizations still use them a lot.

Many industries besides healthcare use **EDI**, which provides a standard data format for electronic document exchange. EDI transactions apply a variety of secure data protocols to protect sensitive data. In healthcare, payers often use EDI for claims processing, and hospitals use it to request treatment authorization from payers.

Flat files (such as spreadsheets, text files, and comma-separated and delimited files) have long been the most basic format for transferring information. In large volumes, flat files become unwieldy for data exchange. With no standards for identifying data elements, identifying things as basic as "male or female" across hundreds or thousands of files require tremendous human effort. But flat files persevere in healthcare. For example, flat files remain the most common format for data transfer in clinical trials.

4 Develop Your Winning, Goal-Based EHR Integration Strategies

It's important to remember that there is no single solution for healthcare data integration. Even as FHIR grows in adoption and promise, it's not a magic cure all. Healthcare lives in a hybrid world today, needing to enable data integration among a new and old mix of FHIR, HL7, EDI, and flat files as it transitions to greater API-based connectivity. This drives complexity and requires a combination of healthcare and technology development expertise that is extremely difficult to find, even for sophisticated healthcare software companies.

Let's look a little closer at a few of the key technologies providers and healthcare technology companies need to understand to advance successful hybrid strategies.

Where to Start

Healthcare data integration planning starts with some common steps:

1

Set your high-level scope and goals for EHR and system integration. Is this a system-wide health data integration effort? Is it meant to solve a single integration objective (for example, make data from your EHR available to patients using a specific app)? What end results do you expect? Are you satisfying compliance requirements, improving care quality and delivery, and ultimately getting a return on improved efficiency? It's a big endeavor; make sure everyone understands and agrees to why you are doing it.

2

Draw your ideal data integration map: Which systems need to share what data and how? Which connections are one-way vs. two-way? If done right, you will also document and understand the functionality, data models, compatibility, and integration endpoints for every system in your data universe. This effort varies significantly depending on the overall integration scope.

3

Develop your hybrid integration strategy to determine which APIs, data formats, and other methods of data exchange you will need to implement and manage for comprehensive interoperability.

4

Establish guidelines for data privacy and protection as you open access to EHRs and other health systems with sensitive information. Communicate this well and often and make sure you are building data security into every part of your integration plans.

5

Develop the detailed technical and project plans for integration across your systems.

6

Create an integration timeline, with incremental milestones for connecting with various systems in your health data universe.

Easy, right?

Clearly each of these steps can become complex and take time and energy. Things like "draw your integration map," "develop your hybrid strategy," and "develop detailed technical and project plans" take a lot of knowledge and effort. For a single, one-way data pass from an EHR to another system, the scope might be a straightforward project to write to the EHR's existing APIs. It gets dizzying for broader integration across multiple technologies (HL7, HL7vX, JSON, FHIR, RESTful APIs) and data types (clinical, pharmacy, financial, claims).

All of this can be frustratingly difficult to complete doing it yourself with limited resources.

CHOOSE YOUR INTEGRATION COMPANION
Don't go up the mountain without a guide.

Just one example: Who on your product or development teams has time to create your complex integration map? It's not a side hobby, and your team could easily spend a year and still not have a complete picture of what needs to connect where and how.

This brings us to the most important recommendation: **find the right interoperability partner**. Whether you are a vendor or provider, your healthcare IT development teams build winning, high-value software solutions that solve big challenges. Here's how experts in healthcare interface technologies (the ones who do this for a living) will help you navigate interoperability:

- Clearly assess and outline your challenges.

- Define your interoperability roadmap and goals, whether it's connecting to one API or connecting dozens of systems within a large provider network. The bigger the scope, the more variables among data exchange technologies and types.

- Identify technologies and exchange systems in place and establish a winning hybrid strategy to create data harmony.

- Establish a confident technology and process path forward and timeline.

- Do the work: Development, testing, QA, documentation, and support for your interoperability goals.

Your integration partner should also bring the right technology expertise. For example, FHIR will be a key part of any healthcare data sharing initiative moving forward. Demand this level of knowledgeable guidance and healthcare technology mastery from any partner you consider.

ABOUT KMS HEALTHCARE

KMS Healthcare is the intersection of world-class technologists and proven Healthcare industry expertise.

We empower companies to build transformative next-gen technologies to bring about game-changing resolutions to healthcare's most challenging problems. We are committed to providing innovative tools and expertise to software companies, payers, life sciences organizations, and providers in order to help create industry-leading health solutions.

Our resources extend your healthcare software teams with expert developers, testers, and strategists, as well as interoperability solutions ensure improved data exchange while maintaining regulatory compliance and data-driven requirements. Covering end-to-end product development, we helped numerous U.S. health practices increase health treatment quality, reduce costs, and improve patient care.
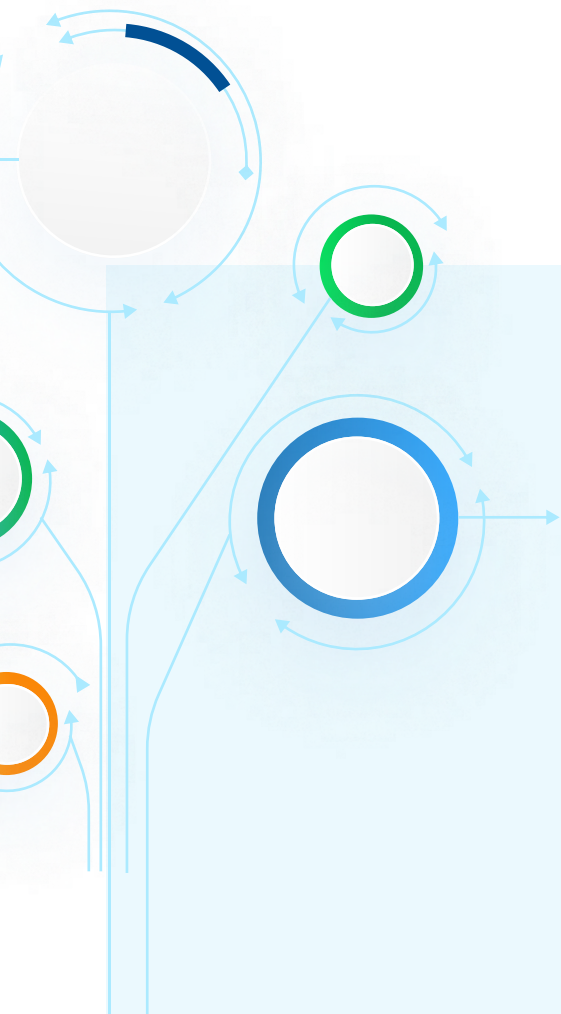
NEXT STEPS

Don't do it alone. Rely on KMS Healthcare as your partner to sort out the right interoperability path for your healthcare systems, whether you're a trusted vendor, provider, payer, or life sciences organization.

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