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The Next-generation of Data Integration: Leading Healthcare's Value-based Transformation

Building the future of healthcare on a data-driven foundation to power efficient outcomes

Executive Summary

The amount of data available in the healthcare space has grown tremendously over the past few years. Healthcare information from electronic health records, claims, laboratory, and pharmacy is increasing every second. There are more than a hundred different types of EHRs in healthcare and each of them generates and parses data in a different format. Apart from creating the issues of interoperability and data exchange across the network, different EHRs and data formats are also a barrier to data acquisition.

Due to the sudden growth in data and the federal government's initiative, **Meaningful Use**, that makes effective application and exchange of electronic data instrumental, healthcare organizations are extremely focused on aggregating and connecting disparate data sets.

One of the biggest challenges with healthcare data integration is that data comes in from multiple sources, in multiple formats.

Transforming or adapting to a newer or popular format of data exchange would be the first step. However, the EHRs implemented at healthcare organizations use their own proprietary format to store and process data. Additionally, most of them follow a "Black Box" architecture, so modifications to the existing model are expensive at best and nearly impossible at worst.

Due to system and integration challenges, almost 44% of healthcare organizations are unable to use all the available data, which costs healthcare $342 billion annually.[1]

The Data Activation Platform enables agile and robust data integration of disparate sources by leveraging Big Data technology. The platform is built to enable true interoperability among various healthcare data systems to deliver actionable insights. With pre-built connectors to 60+ widely-used EHRs, 10+ payers, and multiple data exchange standards, the platform is purpose-built for interoperability. The platform can acquire, ingest, and process data from various sources and store it as a single source of truth. The integrated data obtained can be processed using different pre-built modules and help healthcare executives gain actionable insights.

Challenges with healthcare data activation

In a survey, 95% of the healthcare providers said interoperability challenges limit their ability to transfer data from one medical center to another.[2] Data is stored in different formats, and the implementation rate of common standards is still low due to which data parsing becomes challenging. Additionally, data to be transmitted- be it clinical data systems, claims data systems, RCM systems- are sent using different formats and protocols, like TCP/IP, SFTP, HTTP, web services. Since there are multiple disparate data sources being operated by several 'Black Box' models, coordinating care efficiently for an organization becomes a roadblock in their journey to value-based care.

The most common and significant of all the challenges with a data-driven healthcare is the lack of complete, consistent data that calls for holistic, integrated records.

On a small scale, when the information had to be exchanged within an organization, data from different brands of EHRs was easier to put together. Today, even though more than 78% office-based physicians use a certified EHR to collect and store data about patients and 9 out of every 10 physicians have an EHR[3], only 41% of them are able to share this information across organizations.[4] Several physicians using an EHR still use localized, server-based platforms with no connectivity. Reworking EHR implementation is not possible, as setting them up is a cost-prohibitive initiative, taking up almost $33,000 per physician in mere implementation, with an additional $17,000 per physician annually.[5]

Majorly, there are three key challenges with data integration that create a roadblock for data-driven healthcare:

- **The presence of inconsistent, fragmented, and unstructured data**

  Data in healthcare comes from various EHRs, spreadsheets, standalone applications, medical devices, and a lot more. Instead of integrating vital information and presenting it in unified integrated record, the disconnected sources end up increasing data fragmentation across the network. Moreover, EHRs lack the capability of integrating master patient data obtained from other sources like payer contracts, lab test results, clinical documentation, etc.

- **Black Box Model**

  Many EHRs follow a 'Black Box' approach, where the entire process of data collection and storing takes place on the inside and the end user is unaware of the inside processes. When a data source or an EHR changes their data feed structures, changing the integration interface is a challenge. This usually isn't a major issue until a resource-intensive demand comes up, requiring trustworthy, authoritative information about patients, services, referral networks, and relationships among entities.

Inadequate data sharing standards

Even after complete data collection, it can't be passed on to other stakeholders in the network because of lack of appropriate sharing standards. Different versions of EHRs deployed across various settings have a different underlying schema. Additionally, every data format makes use of different transmission protocols- TCP/IP, SFTP, HTTP, web services. There are also different methodologies for healthcare data transmission- real-time, batched, and late-binding. However, due to lack of incomplete and fragmented incoming data, the process of analytics and transmission takes a hit. This makes data sharing and accessing often unachievable and outcome-based care in real time challenging.

Advancing with an Integrated Approach

Currently, healthcare organizations have multiple datasets- graphic, textual, coded, unstructured, analyzed, filtered, non-filtered, and more. This apart, there are several sources of patient information necessary to consider in the decision-making process such as:

- Lab reports
- Handwritten consultation and prescriptions
- Progress notes from the care teams
- Transcribed and typed operative reports
- Medical history on paper charts

The volume of healthcare data is ever-increasing and providers cannot always retrieve and view valuable information in rapidly-evolving clinical encounters. As a result, healthcare organizations are overwhelmed with multiple and disparate sets of data which results in ineffective and fragmented insights.

An integrated approach towards healthcare is much more than just integrating health information and getting standalone systems to communicate with each other. It is about moving toward delivering integrated care- holistic in terms of input, delivery, and management.

An integrated approach to healthcare can solve multiple issues, and many existing capabilities can be enhanced to optimize outcomes:

- Relevant and useful clinical information at the point of care.
- Improved quality of care and outcomes.
- Improved clinician performance.
- Flexible and accurate patient monitoring.
- Optimized operational efficiency and quality.

Innovaccer's Data Activation Platform- Bringing Big Data to Healthcare

Healthcare data integration is a challenge for many, and Innovaccer's premier Data Activation Platform counters this issue in more than one way. The platform enables agile and robust data integration of disparate sources by leveraging Big Data technology. The platform is built to enable true interoperability among various healthcare data systems to deliver actionable insights.

The Data Activation Platform lets you integrate disparate sources of data without having to write a single line of code by doing most of the heavy-lifting itself. The platform with its agile and modular structure can ingest structured, semi-structured, as well as unstructured data and pool it in as a single source of truth. With a scalable architecture, the Data Activation Platform can work with legacy, upcoming as well as custom-made systems and can grow as the amount of data increases, assimilating data from various sources. The platform can ingest raw data and gives the user the flexibility to configure and reconfigure the underlying structure on the go. Coupled with heuristic analytics, providers can use the integrated records to identify discrepancies, derive meaningful insights, and ensure integrity.

The Data Activation Platform has pre-built connectors to connect with some of the following EMRs/EHRs:

eClinicalWorks, Practice Fusion, HMS, Allscripts, Athenahealth, Intergy, Amazing Charts, Allscripts Professional, AltaPoint, Allscripts MyWay, Care360, e-MDs, SOAPware Inc, GE Centricity, MicroMD, Greenway PrimeSuite, NextGen, Aprima, Advanced Data Systems, Corporation, Allscripts TouchWorks, DoctorsPartner LLC, HealthFusion Inc, McKesson, Medisoft, Office Practicum

The platform allows easy transformation of data and standardization and brings them onto a unified Data Activation Platform. The data processes can be performed in real time, depending on the required frequency. The platform's ETL pipelines allow a detailed overview and comprehensive management of the incoming data, along with the ability to raise alerts and push notifications.

Data Activation Platform's Gateway

The platform has been made to integrate data from any number of sources onto a unified data repository, based on a Hadoop Big Data infrastructure. The platform can ingest a large amount of data from multiple feeds, like:

- CCDA documents
- Connectivity from FHIR spec. sources.
- EMRs
- X12 837/835 files
- ADT feeds
- Flat file dumps/CSV files
- HL7 feeds

The Data Activation Platform Gateway is designed with a drag-and-drop interface that offers to easily build connectors to ingest data from these sources. The platform is equipped with preconfigured templates, facilitating configurations and connections with new data sources in just a click. When EHRs or payers change their data feed structures, changing the entire interface is tedious. Data Activation Platform's Gateways solves this issue to a great extent by offering connections with just a click.

With the Data Activation Platform's visual ETL pipelines and a point-and-click interface, users can examine the broken transformations and have the autonomy to change the underlying schema or user access, right from the user interface to ensure continuity in data ingestion.

The platform offers visual ETL pipelines that facilitate easy identification of broken transformations. Innovaccer's pipeline are designed with a point-and-click interface that offers easy configuration and provide room for any future changes in the underlying schema or user access. The platform is also equipped with preconfigured templates for widely used data sources to facilitate configurations in just a click. With its modular and micro-service architecture, the Data Activation Platform is ideal for integrating distributed datasets. It filters and pushes data on the user's end, while the cleansing and integration processes are performed on the server end.

The Data Activation Platform follows a unique approach in order to build real-time data streams. The data from the user's end follows a 'push' mechanism, instead of a centralized 'pull' mechanism, which gives clients the autonomy to decide how frequently data needs to be streamed and control over what information has to be transmitted.

Once the data is integrated and structured, it is incorporated into a single patient view- Patient 360, powered by Enterprise Master Patient Index (EMPI), which comes with two built-in features:

- Ability to interface with vendor-specific EMPI solutions.
- A built-in, holistic patient repository with a configurable search-and-match algorithm.

Data Activation Platform's Gateway

Data quality can affect care outcomes in the long run and has to be optimal. A data point as simple as the gender of the patient, if parsed and documented imperfectly can have a major effect on a patient's EMPI, resulting in poor quality outcomes. The platform offers a Data Quality tool that identifies data gaps and offers assistance in cleaning up pipelines so that raw data can be easily cleansed, normalized, and ingested into the data lake. The Data Quality tool runs a quality check pre-ingestion and works on presenting data in a cleansed and normalized form and verifies the transformations post-ingestion. In case of any anomaly, the tool alerts developers so that they can take corrective actions to ensure data validity on a continuous basis and have data integrity maintained over time.

The Data Quality tool helps with:

- Examine and fill gaps in raw data
  - Examine the fill rate of data columns
  - Identify and rectify erroneous data sources
- Data profile
  - Setting up data transformations
- Verify correct transformations
  - Reviewing data quality pre- and post- ingestion to ensure accurate data transformations
- Alert developers
  - When an anomaly is detected, the changes in data feeds trigger notifications that alert developers to take remedial actions.

Innovaccer's pipelines can standardize the following types of feeds:

1. Ordering Provider Speciality
2. Servicing Provider Speciality
3. Attending Provider Speciality
4. Admitting Provider Speciality
5. Consulting Provider Speciality
6. Gender
7. Ethnicity
8. Marital Status
9. Relationship
10. Activity Code
11. Allergen Name
12. Allergy Status
13. Immunization Status
14. Admission Type
15. Re-admission Indicator
16. Admit Source
17. Patient Class or Type
18. Discharge Disposition Code
19. Service Type
20. Place of Service
21. Primary Diagnosis Status
22. DRG- (diagnosis-related group)
23. Additional diagnosis
24. Medications
25. Order Status
26. Result Status
27. Procedure Coding System
28. Abnormal tests

29. Transaction Service Code
30. Transaction Type
31. Claim Type Code
32. Adjustment Status
33. Claim Billing Facility Type
34. Revenue Center Code

Enterprise Master Patient Index (EMPI)

After integration and structuring of patient data, the Data Activation Platform's EMPI Tool assigns an Enterprise Master Patient Index (EMPI) to every patient. EMPI employs comprehensive identifier management to identify individuals across organizations during and after processing, storage, or transmission of information. The EMPI module is able to match medical records from across data sources pertaining to the same patient and create a holistic, 360-degree longitudinal patient record. Every record is assigned common, linkable identifiers like patient ID, provider ID, location ID, etc. and the module matches the records based on different data fields, including heuristic models to rectify gaps and redundancies.

The Data Activation Platform's master schema is flexible to account for numerous data sources and is able to normalize, validate, and perform integrity check across various data elements contributing to a Patient-360 profile:

- Patient demographics
- Encounters/visit history
- Vitals
- Diagnoses
- Lab orders
- Lab results
- Prescription/refills
- Procedures
- Immunization history
- Allergies
- Billing details
- Providers associated

Data Integration Landscape

The Data Activation Platform is compatible with a number of widely-used health IT systems to integrate all incoming sources of health information- clinical, lab, financial, pharmacy. Here are some off-the-rack data sources the platform can integrate:

Domain	Coding Standards
Conditions	SNOMED-CT
Medications	RxNorm
Medication Classifications	NDF-RT
Labs	LOINC
Immunizations	CVX
Allergies - Non-drugs	UNII
Allergies - Ingredients	NDF-RT
Allergies - Drugs	RxNorm
Measurements (e.g. vital signs)	LOINC
Documents (e.g. Discharge Summaries or progress notes)	LOINC
Procedures	SNOMED-CT
Financial/ Billing	ICD-9-CM: Volumes 1 & 2 for diagnosis codes ICD-9-CM: Volume 3 for inpatient hospital procedures NDC: National Drug Codes for retail pharmacy claims HCPCS and CPT-4® for physician services and other health services HCPCS for all other substances, equipment, supplies, & other medical supplies CDT® for dental services NDC for retail pharmacy transactions ABC Codes for registered users Diagnostic Related Groups (DRGs) • ASC X12N 837 • ASC X12N 820 • ASC X12N 834 • ASC X12N 835 • ASC X12N 270/271 • ASC X12N 278 • ASC X12N 276/277 • NCPDP Telecommunication Standards

Two-way Interoperability

The biggest challenge organizations face in a network-oriented value-based care approach is having different ways of accessing data. There are several roadblocks on the road to interoperability like the lack of a common standard, restricting state privacy rules, workflow differences, incentives. Some systems are newly-developed and come with built-in interoperability whereas some legacy systems are not wired for data sharing and management. Significant information can be found in HIE connectivity files, HL7 feeds, CCD, flat files, etc. but with the lack of interoperability, the data systems remain disparate and disconnected.

The Data Activation Platform is a truly interoperable platform, facilitating a bidirectional flow of information to help healthcare organizations create a technology backbone and empower them to deliver data-driven outcomes.

Without the means to exchange data, both patients and care teams have to suffer as the information is non-uniformly distributed among care teams. The bidirectional data exchange of the Data Activation Platform provides the capability to push-and-pull data from multiple systems. Care teams are empowered to ingest and send information back into the EHRs in the desired format with supported protocols, data, and standards such as TCP/IP, SFTP, FTP, HISP, HL7, FHIR, and a lot more. With an interactive set of views on performance dashboards, providers can use the summarized data to update the patient chart and share it across the network with standards-based connectivity routes to connect affiliate and authorized clinicians.

The Data Activation Platform is equipped to help providers achieve success with following features:

- **Handling multiple file systems:** The platform being a source-agnostic, Hadoop-based platform, can incorporate multiple file formats, allowing providers to quickly understand and gather meaningful insights out of siloed datasets.

- **Seamless connectivity:** The platform can connect to various health systems, providing them the access to unified patient records at the point of care, in addition to ADT feeds, lab test results, care plans, and much more.

- **Workflow integration and delta views:** The platform has CCOW-compliant EHR extensions to provide seamless access to a unified patient record and can provide a set of views with vital information accessible to the physician at the point of a click.

- **Community connectivity:** The platform uses standards-based connectivity routes to connect network physicians. They only have to subscribe to publish patient information into their EHR and Data Activation Platform does the rest behind the scenes, avoiding costly point-to-point interfaces.

- **Semantics harmonization:** The lack of standardization makes data integration and exchange a challenge. The Data Activation Platform normalizes and standardizes data in a source-agnostic format, making it easier to achieve interoperability across disparate systems.

- **Innovative platform:** To realize strategic goals of value-based reimbursement, healthcare organizations are adopting emerging payment models that require increased interoperability. The Data Activation Platform's service-oriented architecture helps providers catch up with the changes in the industry and deliver new solutions.

How is Innovaccer Leveraging AWS?

With its flexible, reliable, and scalable architecture; AWS powers the backbone of the Data Activation Platform. Using AWS's intelligent data processing and provisioning abilities, the Data Activation platform ingests and processes terabytes of healthcare data from diverse sources including Electronic Health Records, labs, pharmacies, hospitals, and labs regularly. It's AWS in the background supporting DAP that ensures administrators can spin up servers, upgrade, and downgrade resource allocation depending on the load balancing requirements. The efficient AWS infrastructure gives total control to developers ingesting large volumes of data from multiple systems so that our clients can get real-time insights delivered from analyzing huge datasets without any latencies and downtimes.

The platform utilizes an array of AWS services, including Amazon Relational Database Service to seamlessly exchange integrated patient records in real-time, Amazon Simple Storage Service to manage data ingestion from multiple sources, which is later ingested and analyzed through a Hadoop based cluster using Amazon Elastic Compute instances. Using AWS, Innovaccer delivers powerful insights to its healthcare customers to boost real-time collaboration for improved care delivery. The cloud platform ensures that Innovaccer can add or replace servers in minutes, save crucial time usually spent on infrastructure refreshes, and accelerate deployment times.

With Amazon Redshift, Innovaccer was able to achieve the best-rated time-to-value in transforming data to analytics and delivering ROI. Providing the capability to build and run ETL pipelines using drag and drop modules, Innovaccer's platform could integrate data across multiple sources in about half the time compared to industry standards and at 70% less cost. We were using EC2 servers for the entire Hadoop cluster and it usually ran 15-20 r4.4x large machines for 15-20 hours daily for each customer, the cost began to rise significantly.

Conclusion

Thanks to technology and innovation, healthcare, much like any other sector is being transformed rapidly. The challenge for most health systems is the ability to integrate disparate data systems and developing a system to collect and record all patient information after discharge. The integration, aggregation, and harmonization of data to make it all available to multiple users across a network are daunting tasks for healthcare information technology.

Interoperability between healthcare systems is the most important step in achieving value-based care. There have to be new measures, new developments, and new tools to ensure timely data sharing, and in turn, better population health. There are many challenges along the way which have to be countered with a pragmatic approach about what data is required and how will it be exchanged.

With the Data Activation Platform's truly interoperable platform offering advanced analytics, bi-directional exchange capabilities to enhance communication, providers can worry less about data gaps or security; and work on improving care quality and sustaining their growth in the era of value-based reimbursements.

About Innovaccer

Innovaccer is a leading San Francisco-based healthcare technology company committed to making a powerful and enduring difference in the way care is delivered. The company leverages artificial intelligence and analytics to automate routine workflows and reduce manual overhead to facilitate more patient-centered care. Its Gartner and KLAS-recognized products have been deployed all over the U.S. across more than 1,000 locations, enabling more than 25,000 providers to transform care delivery and work collaboratively. Innovaccer's Data Activation Platform has been successfully implemented in healthcare institutions, government organizations, and corporate enterprises including Catholic Health Initiatives, MercyOne, Orlando Health, Hartford Healthcare, and Stratifi Health. By using the connected care framework, Innovaccer has unified 3.8 million patient records and generated more than $400M in savings.

For more information, please visit innovaccer.com.

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Suite 1829, Floor 18th,
535 Mission St, CA 94105
1.650.479.4891
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