WHITE PAPER

Improve population health and drive operational insights with artificial intelligence and machine learning

Learn how a holistic repository of data with AI and ML improve efforts to address risks in community health by delivering electronic clinical quality measures and value-based care optimization

The emerging data opportunity for population health initiatives

Attempts to harness the value of data across the healthcare industry have previously been hampered by a multitude of complexity and integration challenges. Diverse datasets spread across siloed systems and the lack of industry-wide data interoperability impede population health initiatives and disrupt the delivery of equitable care to patients who desperately need it.

Fortunately, emerging data integration and modernization solutions promise to turn the tide. These solutions can seamlessly integrate clinical and external data, like Social Determinants of Health (SDoH)[1] and claims data, to provide holistic clarity into individuals within a patient population. Data integration also paves the way to AI-driven analytics, which healthcare professionals can leverage to inform patient treatments based on their medical history, identify health risks across a community, and establish better electronic clinical quality measures (eCQMs).

These opportunities aside, external pressures like reimbursement reduction, stringent clinical quality reporting mandates and enforceable rules on price transparency further underscore the importance of seamlessly bringing together diverse data sources across the healthcare industry.

Forward progress clearly lies in the integration and modernization of health data. Healthcare organizations looking to effectively transition without overextending resources can look to partner with established industry leaders like AWS and Infor that provide end-to-end data integration, modernization, and built-in AI and Machine Learning (ML) tools to improve precision care, clinical quality reporting, and population health – for the benefit of all.

1. SDoH

Integration and modernization: Unlocking data's value for population health management

The first step to addressing population health is obtaining visibility over existing gaps in patient care, which can be done through the aggregation and analysis of different data – from clinical data like electronic health records (EHR) to external sources like Social Determinants of Health (SDoH) and claims data. Only then can healthcare organizations gain clarity over all disparities in patient treatment, and take the necessary steps towards accessible, targeted, and affordable care to the community,[2] thus accelerating the shift towards value-based health outcomes. An additional range of emerging factors (including SDoH and non-clinical data) are also influencing the need for better integration and modernization of clinical data.

These include:

1. The need for ACOs to prove tangible impact on population health

Due to growing healthcare costs and public scrutiny, Accountable Care Organizations (ACOs) face more pressure than ever before to strike a balance between clinical treatment protocols and total cost of care. Because they are only paid by Medicare once they can prove that a treatment is improving a patient's health, ACOs must be able to analyze a patient's background, so appropriate care and targeted treatment approaches can be administered, while wasteful costs are kept low.

The integration of disparate sources of patient data is crucial to providing an ACO's physicians and specialists with the holistic picture of the patient's data to coordinate care. Thia entails pulling together data from disparate data sources - EHRs, operational data like claims data from internal systems and 3rd party providers (e.g., Medicare data) for deeper analysis and risk-based stratification.

Forward-thinking ACOs could also benefit from the use of AI-powered data analysis, which allows them to proactively identify risk of chronic diseases within the patient population – allowing them to conduct early intervention that prevents the need for costly treatments and care down the line.

2. Improved clinical quality measures for reporting and risk management

With the healthcare industry increasingly transitioning towards value-based patient care, there is a need to rethink electronic clinical quality measures (eCQMs) that are realistically backed by data from clinical trials, chronic disease risk, and Social Determinants of Health (SDoH). Besides reporting requirements, these improved measures will allow healthcare organizations to analyze and identify gaps in quality care within a cohort, and address those gaps before they impact population health outcomes.

This requires the integration and analysis of population health data from various sources – but the process has largely been sub-optimal for most healthcare organizations. This slows down assessment and monitoring of clinical quality measures across a healthcare population, while also hamstringing efforts to provide real-time eCQMs reporting to health providers and federal health agencies – which impacts care coordination and interoperability.

Starting from 2025, healthcare organizations must deliver eCQMs reporting on the entire qualified patient population and payer types,[3] instead of just Medicaid patients. This further underlines the need for seamless and automated data collection and modernization of workflows, reducing the need for manual collection and mapping of clinical quality data.[4]

2. Overarching Goals
3. Policy Solutions to Facilitate the New eCQM ACO Reporting and Advancement of Interoperability
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3. The need to remove interoperability barriers within and outside healthcare

The pursuit for greater interoperability aims to remove barriers to the seamless exchange of patient data within healthcare, but its benefits also extend to coordination with external organizations that are key to overcoming gaps in public health. Social service agencies can provide Social Determinants of Health (SDoH) data that are essential for healthcare professionals to understand why a patient can't afford treatment or is at risk of a particular chronic disease, allowing them to ensure that there are support mechanisms best suited to a patient's requirements.

The challenge to interoperability and integration of data from external sources is the lack of consistent adoption of industry-wide standards. Healthcare organizations commonly utilize legacy data formats like HL7 V2 or CDA within EHR systems, while SDoH data is typically unstructured text within reports or care/clinical notes. To ensure they can fully leverage SDoH data to empower population health initiatives, healthcare organizations must obtain capabilities to convert both clinical and non-clinical data into standardized modern formats, like HL7 FHIR.

Healthcare organizations can also tap into next-generation technologies like NLP (Natural Language Processing), language-based AI foundational models to extract discrete data from unstructured sources into usable formats, automating the difficult task of consuming large volumes of data. This leads to analysis of all the patient/SDoH data for population health analysis, patient triage, and efforts to proactively identify healthcare gaps and risks within underprivileged communities.

4. Integration with external applications for a smoother patient experience

Transforming clinical data to FHIR opens it up to be exposed to the APIs of mobile applications or web services, making an end-to-end patient experience possible. Take transportation coverage under Medicaid for instance. Exposing patient discharge or appointment data to ride-share applications like Uber or Lyft allows ride ordering (via 3rd party partners) and payment to be handled through APIs, negating the need to build additional infrastructure or workflows.

Another example is integration with electronic signature software. Implementing a workflow between EHR and electronic signature software provides patients the option to electronically sign all forms and paperwork before they even show up at the hospital. This level of automation minimizes friction for the patient, shortens the time to treatment, and creates a positive experience that raises the patient satisfaction scores of healthcare organizations.

There are plenty of benefits to support the need for improved data integration and modernization within healthcare, but the technical and implementation requirements can be significant. One way to overcome this is to tap into the proven solutions from industry leaders like AWS and Infor, allowing healthcare organizations to immediately obtain and use powerful data capabilities to advance interoperability and patient care – without sacrificing the time, energy, and resources that should be funneled towards building solutions that advance population health initiatives.

AWS and Infor: A partnership to deliver & scale healthcare data integration and interoperability

With these use cases in mind, the integration and modernization of data is a clear imperative for all forward-thinking healthcare organization. To reduce complexity and minimize user friction, a unified solution that provides a seamless workflow from data integration to modernization to storage and application would be the ideal choice for any discerning healthcare organization.

Combining the cloud-based expertise and capabilities of two leaders in healthcare solutions, the AWS and Infor partnership provides healthcare organizations with a suite of data solutions they need to break down data siloes and fully leverage the insights within their data to benefit and drive population health management outcomes.

Working with AWS and Infor equips healthcare and life sciences organizations with three purpose-designed, scalable, and compliant solutions:

Infor Cloverleaf® Integration Suite	**Infor FHIR On Ramp (IFOR)**	**AWS HealthLake**
A cloud-based integration platform designed to unify clinical data and systems, paving the way to interoperability and virtualization.	Built on the Cloverleaf Integration engine, Infor IFOR transforms and loads legacy data formats into FHIR R4 for use on AWS HealthLake.	**AWS HealthLake** is a HIPAA-eligible service that provides FHIR APIs that help healthcare and life sciences companies securely store, transform, transact, and analyze health data in minutes to give a chronological view at the patient and population-level.

Infor Cloverleaf

The panacea to the inherent complexity of disparate systems, datasets, and solutions in modern healthcare organizations is a highly intuitive, yet robust integration platform like Infor Cloverleaf. Designed from the ground up for the average healthcare operations professional and expert technical staff, Infor Cloverleaf provides agile and easy-to-use integration capabilities that are fundamental to building better interoperability and care coordination for today's healthcare organizations.

- **Frictionless data aggregation and modernization**. Transform legacy data formats like HL7 V2, HL7 CDA, and X12, encoded data like XML, and clinical data within EHR or ERP systems into the current HL7 FHIR standard format. Ensure clinical data readiness for compliance audits, analytics, and FHIR enabled applications.
- **Bridge and access the emerging FHIR ecosystem**. Utilize the FHIR Bridge to connect legacy health systems with the emerging FHIR-based application ecosystem, using a series of pre-built FHIR configurations, functions, and adapters. Ensure your healthcare professionals and staff retain access to the cutting-edge tools they need to be productive and deliver the best health outcomes possible.
- **Integrate disparate health systems and workflows**. Connect and integrate different mission-critical systems and workflows to ensure data is leveraged where it's needed. Bring together clinical systems, claims data, and patient information onto a single unified view (Patient 360) to aid decision-making and enable more holistic healthcare outcomes.
- **Securely connect with external services or applications**. Leverage the Infor OS API Gateway to ensure seamless and secure two-way data exchanges between your organization and external providers (e.g. Health Information Exchanges-HIEs), as well as web or mobile applications via RESTful APIs – allowing for the creation of end-to-end healthcare and patient services.
- **Securely store clinical data on AWS HealthLake**. Seamlessly move clinical data in and out of AWS HealthLake, a HIPAA-eligible service from Amazon Web Services. Get the reliable, scalable, and secure cloud repository you need to leverage next-gen technology, conduct population health analytics, and create new patient experiences.

Infor FHIR On Ramp (IFOR)

The healthcare industry often faces great difficulty and expense when looking to store vast amounts of clinical data in a manner that's secure, compliant, and accessible for analytics and digital transformation initiatives. The Infor FHIR On Ramp (IFOR) solution was created to address this challenge – giving healthcare organizations a clear path to the secure and scalable data storage capabilities of our partners, Amazon Web Services product HealthLake.

- **On-demand conversions of clinical data for AWS HealthLake**. Infor IFOR enables real-time, batch conversions of legacy data into the latest FHIR R4 format for storage in an AWS HealthLake instance. This allows health organizations to leverage the value of their existing data for FHIR-based applications on the cloud, without the complexity of building time-consuming data conversion and mapping workflows.
- **Reverse conversions of FHIR R4 back to legacy data formats**. Seamlessly convert data in FHIR R4 back into custom formats for further applications within traditional health systems or platforms. Health organizations can run analytics and enrichment on AWS HealthLake, before importing newly updated data back to inform decision-making or to guide initiatives to enhance population health outcomes.
- **An intuitive, cost-efficient, and code-free user experience**. Built with an easy-to-use web interface, Infor IFOR makes the data migration process intuitive and simple for the average health professional and analyst – with no coding experience required. Healthcare organizations can also leverage pre-built mappings and connectors from the FHIR Bridge library to minimize implementation complexity and simplify the user experience, lowering costs and improving return on investment.

AWS HealthLake

AWS HealthLake is a HIPAA-eligible service that facilitates clinical data ingestion, storage, and analysis using the Healthcare Interoperability FHIR R4 specification. Utilized alongside Infor IFOR, AWS HealthLake allows healthcare organizations to use a variety of unstructured data sources such as progress notes, clinical notes and lab reports, for population health analysis and implementation of next-generation technologies like language-based AI.

Key capabilities of AWS HealthLake are:

- **Rapid and easy ingestion of clinical data**. Healthcare organizations can move large volumes of FHIR R4 data through Infor "IFOR in bulk", reducing the time and technical constraints of healthcare projects with large data requirements, such as data analytics or AI language-based LLM or NLP driven opportunities.
- **Secure and HIPAA-eligible clinical data storage capabilities**. FHIR data is stored in an Amazon Simple Storage Service (S3) bucket, which makes it easy to query while being highly secure due to stringent data security controls. HealthLake also creates a complete and detailed chronological (time lapse) view of all FHIR data, providing a holistic view of the patient with an understanding of disease progression.
- **Robust integration and application with modern solutions**. The availability in HealthLake of FHIR REST APIs allows for the utilization of CRUD (Create, Read, Update, and Delete) applications such as FHIR-based patient solutions that allow for seamless patient data management, appointment scheduling, and billing. Built-in database (via AWS Athena product) integration allows for the creation of SQL-based queries for complex filtering of datasets, driving machine learning models or Amazon QuickSight analytics/dashboards.
- **Transformation of unstructured data with integrated NLP**. Healthcare organizations also have the option to leverage Natural Language Processing (NLP) capabilities in HealthLake to process unstructured data – like clinical notes, progress notes, or research data – to extract discrete data and associate it with standard taxonomies (e.g., ICD-10, SNOWMED…) leading into usable data formats. Using Machine Learning models that are trained to understand context and language within the healthcare domain and entity-based analysis, HealthLake can provide healthcare organizations with a way to rapidly advance population health trends, outcomes, and costs.

Get the technological edge you need to improve population health outcomes

Only through successful data integration, modernization, and improved data analysis can the healthcare industry overcome the biggest barrier to impactful population health management – "Holistic Patient Data". Achieving this broad unification of clinical data, without the cost and complexity of self-implementation, is now possible due to the AWS and Infor partnership.

Numerous health systems and organizations across the U.S. and the world have benefitted from the combined expertise and experience of AWS and Infor. With strategic use, strong internal collaboration, and data best practices, end-to-end solutions like Infor Cloverleaf, Infor IFOR and AWS HealthLake have the potential to enable the following:

- **Clear insight into the gaps or disparities in population healthcare.** Integrating data across all health systems, including that from external providers/partners/HIEs (Health Information Exchanges), equips healthcare organizations with deep insight into patient populations that are underserved or locked out of quality care because they previously didn't have access to healthcare plans. Healthcare professionals can also leverage data analytics to stratify patients based on risk criteria or health issues within cohorts of the patient population, allowing for targeted prevention and intervention – raising health equity and quality of life for minorities and low-income individuals within the population.
- **Advanced patient population care with real-time eCQMs.** Near real-time integration of both clinical and operational/claims data within a patient population allows healthcare professionals to gain a more comprehensive view of a patient's health, which in turn enhances eCQM processing. Physicians can make more informed decisions based on a patient's fully integrated medical history – allowing for more personalized care, early life-saving interventions, and equitable levels of treatment.

  Data integration also facilitates more accurate and up-to-date eCQM reporting, which is a boon for healthcare organizations in the areas of regulatory compliance or adherence to health provider requirements. The visibility into a patient's integrated history allows for the reduction in unnecessary tests and other avoidable healthcare costs, while also paving way for the use of innovative solutions – like advanced analytics or AI applications – to evaluate health risks or areas of enhancement within a patient population.

- **Greater alignment with value-based healthcare.** Thanks to a more integrated data fabric, patient information, payer data, and treatment planning can be more seamlessly brought together for insightful healthcare delivery. This allows for better care coordination, quality care, and reduced costs from unnecessary or inaccurate treatment plans.
- **Compliance with new healthcare rules and mandates.** Data integration produces a coherent and unified view of costs along the health supply chain, supporting compliance with price transparency laws. The seamless flow of data across internal and external systems enables automation of Prior Authorization (PA) workflows, reducing the burden on physicians and the risk of manual errors that lead to treatment delays for patients.
- **Improved patient satisfaction and experience.** When healthcare has access to the bigger picture provided through data integration, the focus can be on providing targeted and appropriate levels of care to individuals within the population. Patients will have access to accurate treatment prices to make financial decisions and are likelier to obtain approvals for treatment plans from insurance companies due to faster PA approvals.
- **Data repository for AI/ML.** The AI/ML and Gen AI puts a heavy demand on easy access to large volumes of structured data, the basis for predictive analytics and Gen AI data summarization. The data repository will also deliver a 360 degree view of the data that will enhance the capabilities of AI/ML.

Population health management remains a huge undertaking that's rife with challenges, but the barriers are significantly lower when healthcare professionals have access to the totality of data they need in real-time to make informed decisions and provide the optimal treatment to patients. Further empowered by data analytics tools and AI/ML models, data integration and modernization will allow healthcare organizations to take a proactive, instead of reactive, approach to addressing the gaps and deficiencies in population health.

An end-to-end, purpose-built, data solution suite remains a key component to building population health programs that scale with the ever-growing health needs of today's patients. Leveraging the industry knowledge and cloud-based expertise of both AWS and Infor promises to slingshot healthcare organizations into wielding clinical data more effectively, to keep costs low, operations compliant, and – most importantly – their patient population healthy and cared for today and years to come.

About AWS

Population health on AWS is comprised of services and partner solutions designed to help customers harness structured and un-structured data on multiple determinants of health to inform clinical and community intervention, interoperate with payors and the care ecosystem.

Factors affecting population health include behavior, genetics, environment, medical care, and social factors, such as where people are born, work, and live. Utilizing information from EHRs, claims, operations, public health statistics, and more on AWS, customers can gain a more comprehensive view of determinants of health.

The pathway to advancing population health begins with data interoperability which enables analytics to drive targeted interventions – improving the health of individuals and communities through disease prevention, early detection, treatment, and improved health equity.

AWS enables healthcare organizations to more easily explore and deploy new and innovative technologies for population health—to benefit patients, providers, and communities.

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