Accelerating Healthcare Innovation through AWS Technologies

Contents

Introduction

As an Healthcare Services Partner of AWS, DataArt accumulated significant expertise in leveraging the latest technologies for digital transformation in healthcare. With 420+ healthcare experts and 18+ years of combined experience in healthcare and life science, we have been successfully helping organizations streamline processes, enhance data security, and improve operational efficiency.

This white paper explores the transformative potential of AWS technologies in revolutionizing data engineering practices and driving innovation in healthcare. We will explore possible strategies for efficient data management and regulatory compliance, as well as practical case studies showing the tangible impact of leveraging AWS technologies.

We will look into several AWS services, including AWS Step Functions, AWS Batch, AWS Glue, AWS S3, AWS Athena, AWS Config, AWS Audit Manager, and Macie, and outline practical steps for organizations to implement these services to enhance efficiency. We will demonstrate real-life examples of how cloud solutions have evolved to be user-friendly and accessible for a wider audience, even with limited programming experience or any prior AWS knowledge.

This white paper highlights AWS's potential to transform the healthcare business and aims to empower organizations to embrace innovative technologies for better efficiency and patient care.

Optimizing NCBI Data Synchronization: Effective Approaches and Key AWS Services

In the dynamic world of healthcare, timely access to accurate medical data can mean the difference between life and death. **The National Center for Biotechnology Information (NCBI)** is a vital resource, housing an immense wealth of healthcare-related information. However, working with this data requires efficient extraction and synchronized updating, posing a significant challenge for healthcare organizations. Studies reveal that up to **70% of healthcare providers** need help with data integration and exchange issues.

Below, we will discuss effective AWS (Amazon Web Services) approaches that could be helpful when optimizing NCBI data interactions. With AWS, we unveil game-changing solutions that will revolutionize your data engineering practices and empower your healthcare initiatives. We will also explore the challenges associated with NCBI data synchronization and examine strategies to streamline the process using AWS Step Functions, AWS Batch, and AWS Glue.

The Importance of Data in Healthcare

Data in the healthcare industry is pivotal for research, diagnosis, treatment, and overall patient care, providing valuable insights into disease patterns, treatment outcomes, and population health trends. Access to accurate and up-to-date data is essential for healthcare professionals, researchers, and policymakers to make informed decisions and improve care quality. Consider these key facts:

• According to a World Health Organization (WHO) report, data analytics can reduce global healthcare costs by **8-12% in the next decade**.

• NCBI offers access to over 30 million citations from the PubMed database and stores more than 200 billion nucleotide bases in its GenBank, along with laboratory research.

• The NCBI's Sequence Read Archive (SRA)

contains petabytes of genomic data, making it a treasure trove for researchers and healthcare professionals worldwide.

Harnessing the power of National Center for Biotechnology Information (NCBI), Federal Inter-agency Traumatic Brain Injury Research (FITBIR), and other open data sources can revolutionize medical diagnoses, discover new treatments, deepen our understanding of various diseases, and open the possibilities for further research, all without having access to private data. However, organizing and synchronizing vast data from such sources demands time and effort.

Understanding NCBI and Its Challenges

NCBI is a renowned repository that collects extensive biomedical and genomic data. Researchers and healthcare professionals rely on its databases to access relevant information for their studies and clinical practices. It is the first step in any project, requiring data extraction while ensuring completeness, consistency, and currency. Yet, managing and synchronizing NCBI data presents several challenges:

- **NCBI's data structure and naming convention** could sound cryptic (own data coding and relations agreements), requiring a significant learning curve. Without proper insight into the data, it becomes challenging.

- **NCBI hosts immense data**, including genetic sequences, scientific articles, and clinical data. As the volume grows exponentially, keeping track of data updates and changes becomes increasingly demanding. Efficiently synchronizing this vast amount of data requires a robust and scalable system.

- **The data available in NCBI's various databases is often heterogeneous**, coming from different sources and following other formats and standards. Integrating and normalizing this data to derive meaningful insights can be time-consuming and complex.

- **The data in NCBI is frequently updated with new research findings** and clinical information. Ensuring the synchronized data is up-to-date and reflects the latest discoveries requires a reliable and automated mechanism.

- **The data might need improved structuring** and could contain duplicate entries. Therefore, adopting a proficient approach to data analysis becomes pivotal for its effective utilization. Before writing code, it is necessary to sample the data and discover its constraints and flaws. This process involves downloading the data, examining it, and recognizing that different samples and research results may be listed multiple times.

Unveiling Data Insights

A preliminary data investigation is crucial in assessing the complexity, correctness, and challenges of the data we will be working with. It comprises:

1. Data Sampling

Selection of a representative data subset for analysis, enabling us to understand the data's structure, size, and potential issues.

This step also helps us determine what is important and what could be discarded to simplify the data analysis pipeline. Locating duplicates, which could be domain-specific, is crucial to rejecting any false positive and conflicting results, immediately avoiding data corruption and issues.

2. Preliminary Assessment with Local Investigation

Primary data analysis and exploration are performed on a smaller scale, helping identify any immediate data quality or formatting issues that need attention.

Jupyter Notebooks are used to get better insights on the data running locally, analyzing the data retrieved using best-in-spot technologies like R, Python, and Pandas. Jupyter products will be used across the whole data analysis pipeline, including the native support in AWS Athena.

Based on the insights found, the data rules could be pre-defined and tested immediately before deploying them into the larger scale of the data pipeline application.
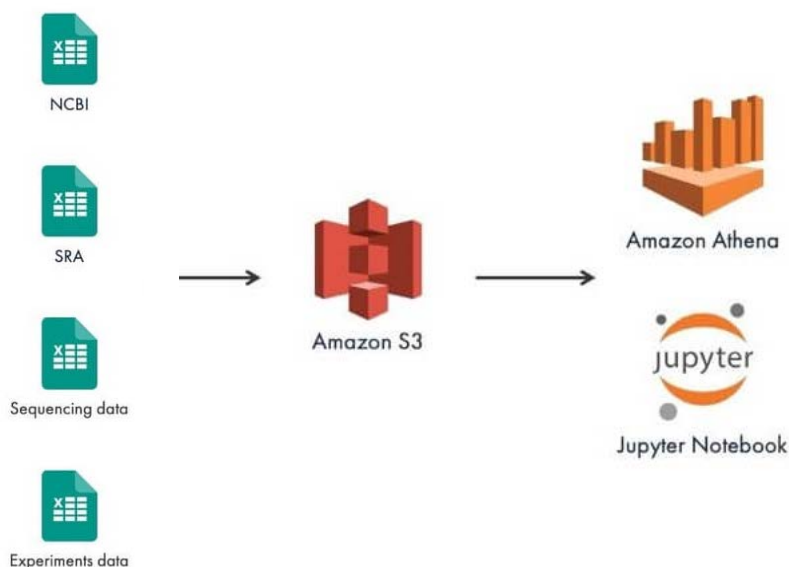
3. Complex Data Assessment with AWS S3 and AWS Athena

Fig.1

AWS S3 and **AWS Athena** come into play for a more in-depth and complex data assessment. Leveraging AWS S3, we can efficiently store and manage large volumes of data, holding the extracted datasets and sequencing data from NCBI SRA for intermediate analysis and variants extraction. AWS Athena, a serverless interactive query service, allows us to run SQL queries directly on the data in S3, enabling faster and more flexible analysis.

Jupyter Notebooks are used with AWS S3 and AWS Athena to facilitate interactive data exploration and analysis. These notebooks provide an interactive and collaborative environment, allowing data scientists and researchers to perform complex computations and visualize the results effectively.

We gain valuable insights into the data's characteristics through this data investigation and NCBI data discovery process with AWS, which help us make informed decisions on processing and analyzing it further for valuable healthcare research and insights.

Organizing the Process for Efficient Data Synchronization

To mitigate NCBI data synchronization challenges, it is essential to establish an organized process that can handle the volume, heterogeneity, and frequent data updates. Leveraging AWS services can provide a scalable and resilient infrastructure to streamline the synchronization process.

AWS Step Functions allows you to build and coordinate serverless workflows that can automate synchronization, reducing manual efforts and ensuring a consistent and reliable data synchronization process.
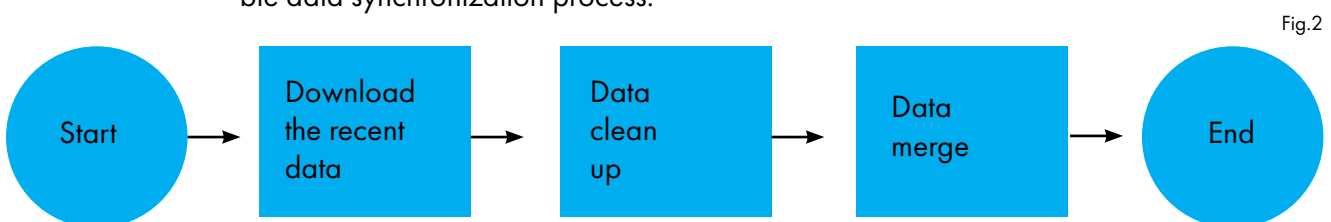
Fig.2

AWS Batch enables you to efficiently process large volumes of data in parallel. By utilizing Batch, you can distribute the workload across multiple resources, optimizing the synchronization process for speed and scalability. This is particularly useful when dealing with the massive amount of data available in NCBI.

Fig.3

Bring the Resiliency with AWS Step Functions and AWS Batch			
Seamless Workflow Orchestration with AWS Step Functions	Scalable and Parallel Data Processing with AWS Batch	Increased Resiliency and Fault Tolerance	Cost Optimization and Elasticity

Optimizing NCBI Data Potential

By optimizing data management and proactively addressing challenges, researchers can harness the full potential of NCBI's data resources to produce more accurate and impactful research outcomes.

To achieve these goals and overcome potential challenges, researchers can employ the following strategies:

Data Offsets Management: A correct fetching mechanism ensures complete and accurate data retrieval, minimizing gaps or data duplications.

Efficient Data Queries and Fair Use Policy: Leverage the Entrez querying language to pinpoint specific data, ensuring the fair use of services, which helps NCBI tune its system to the demand and allow all parties to access it.

Addressing Open System Challenges: As an open system, NCBI may face issues such as API abuse and Distributed Denial of Service (DDoS) attacks, leading to temporary API outages. Preparing for such contingencies is crucial to maintain reliability.

Proper Reliability: Implement correct retry mechanisms and alerts to account for potential failures, faulty data, or API changes. A well-prepared reliability strategy ensures continuous data access and minimizes disruptions.

Low-Quality Data Traceability: Working with low-quality data can be overwhelming. Implementing a verbose system to provide data synchronization transparency is crucial for effectively identifying and addressing data issues.

Optimizing the Data and Ensuring Its Quality with AWS Glue

After the data is downloaded, we encounter the need to process a large volume of data with varying formats and sources. AWS Glue is a fully managed extract, transform, and load (ETL) service that can help ensure the quality and integrity of synchronized data from NCBI and other sources.

AWS Glue accomplishes the following:

- Data discovery to populate the Data Catalog

- A wide range of connectors to various databases to read and write the results from/to

- Keep track of which data is processed and which is not

Using Glue's Data Catalog schema registry, you can enforce data consistency and ensure the synchronized data adheres to the defined standards. Furthermore, Glue supports data transformation and can perform complex data manipulations to harmonize heterogeneous data from different sources, including data cleansing, normalization, and standardization, resulting in a unified and usable dataset.

Also, since it relies on the AWS Data Catalog, it is possible to investigate the data with AWS Athena.

Conclusion

Synchronizing data from NCBI is a critical task for healthcare professionals and researchers. The vast volume and frequent data updates pose challenges that require a well-organized and efficient process.

Leveraging AWS services streamlines the process, offering a scalable, resilient, and cost-effective infrastructure to manage the complexities associated with NCBI data synchronization. Automating workflows and handling large data volumes become easier, ensuring data quality and timely updates.

HIPAA Compliance with AWS Policy as Code: A Code-Driven Approach to Healthcare Security

In a world where change is the only constant, organizations operating in highly regulated industries, such as healthcare, are subjected to regular audits due to numerous industry standards and legal and regulatory requirements, including System and Organization Controls (SOC) and the Health Insurance Portability and Accountability Act (HIPAA).

The Health Insurance Portability and Accountability Act (HIPAA) was established in 1996 to safeguard patients' medical information and ensure the privacy and security of their sensitive data. In the United States, HIPAA stands as the primary legislation governing health information processing.

Established and experienced organizations typically have well-defined second and third lines of defense to identify control gaps and manage risks. With the rapid growth of cloud computing, the focus of compliance and audit programs has shifted to the assets stored in the cloud.

According to **Vantage Market Research**, the healthcare cloud computing market is projected to expand at a CAGR of 18.74% from 2021 to 2028, with an estimated market value of $128.19 billion by the end of the forecast period. AWS provides a wide array of HIPAA-compliant services to build highly scalable, fault-tolerant, and secure solutions that cater to many healthcare use cases.

As we delve deeper into maintaining HIPAA compliance in healthcare, it becomes clear that leveraging AWS services and features can significantly simplify the process. By doing so, companies can ensure their infrastructure aligns with HIPAA and other regulatory

HIPAA COMPLIANT

requirements and decrease the time it takes to conduct audits. Let us take a closer look at how AWS can help healthcare organizations meet their compliance needs.

Is AWS HIPAA Compliant?

AWS, a key player in the cloud services domain, complies with HIPAA regulations, meaning it can host cloud-based systems handling electronic personal health information (ePHI). However, using AWS services does not automatically make your solution HIPAA compliant. When dealing with ePHI in an AWS-based system, you must comply with AWS's HIPAA security requirements and regulations. Let us dive deeper into what it takes.

The best example is **Relational Database Service (RDS)**. This fully managed database service simplifies database operations such as PostgreSQL and SQL Server in the cloud, and it is on the **AWS HIPAA Eligible Services List.** However, it does not guarantee compliance by default. You must still configure it for:

- **Encryption of the rest** of the database, backups, read replicas, and snapshots using AWS KMS.
- Enabling and enforcing **encryption in transit** via SSL/TLS for secure connections.

Being HIPAA compliant on AWS depends on how well you can implement the necessary measures on the platform. AWS can help you create high-capacity systems that handle large amounts of ePHI while meeting HIPAA regulations.

Efficient Compliance with AWS:
Simplified Audits and Centralized Measures

AWS has developed an extensive toolkit for compliance, streamlining the process and minimizing comprehensive audit durations. By implementing compliance policies, companies can efficiently propagate these tools across all structures, ensuring a centralized approach to conformity to guarantee the necessary adherence measures are in place throughout the organization.

The **AWS Compliance Program** helps customers understand the controls in place at AWS. It ensures security and compliance in the cloud by combining governance-focused and audit-friendly service features with relevant compliance or audit standards. One such service is AWS Config, which enables customers to create and operate within a secure AWS control environment.

Enforcing Compliance with AWS Config

AWS Config (Fig.4, p.13) introduces the concept of a Conformance Pack that comprises rules created by AWS for specific industries. Organizations can achieve HIPAA compliance by utilizing the **Conformance Pack for HIPAA** with AWS Config and ensuring their architecture adheres to the

best practices. This information helps conduct audits and identify areas that need improvement, which can then be transformed into actionable items to achieve HIPAA compliance.

Fig.4
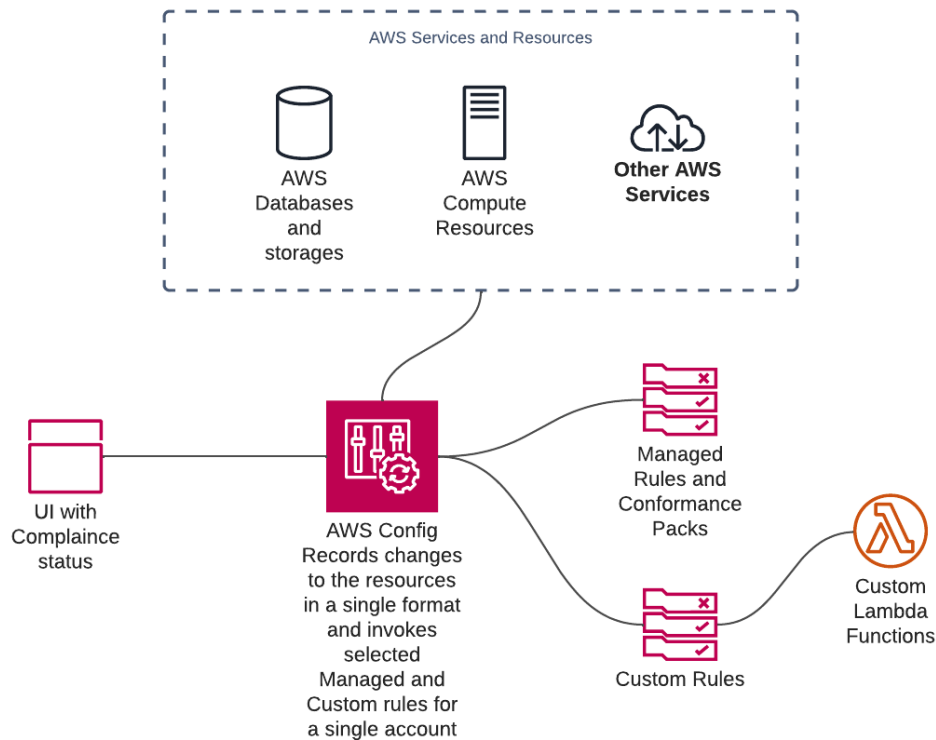
The Conformance Pack automates checks for best practices, making it possible for organizations to comply with criteria outside the pre-defined pack by being «well-architected». (Fig. 5, p.14)

AWS also allows the creation of custom Conformance Packs with a range of **AWS Config checks**, enabling organizations to automate tests for typically manual-assessed policies. By leveraging the cloud, organizations can execute these checks with minimal impact and ensure compliance.

For instance, suppose a company has multiple AWS accounts and a complex organizational structure. The organization may have internal compliance policies that require specific naming conventions and document review policies, among other things. It might require more than relying on the HIPAA Conformance Pack. So, creating a customized Conformance Pack that includes these policies and distributing them within the organization can help establish «policy as code.»

By centralizing compliance in AWS, organizations can identify improvement areas and incorporate compliance-related fixes into their product roadmaps, bringing compliance closer to product development. This approach fosters department collaboration and avoids conflicts where compliance decisions impede product development.

Key Pillars of AWS Well-Architected Framework				
Operational Excellence	Security	Reliability	Performance Efficiency	Cost Optimization

In other words, the "policy as code" helps to improve the software development process by automatically and continuously providing evidence for compliance audits based on selected regulations. Implementing compliance as code involves defining compliance policies to be expressed as tests.

The elasticity of cloud services, particularly AWS, allows for real-time compliance assessment without the need for scheduled audits. However, this flexibility often intimidates people because they need help comprehending vast opportunities. As a result, numerous enterprise organizations perform audits close to releases, resulting in slower time-to-market and decreased overall velocity.

Compliance is a crucial aspect that cannot be ignored, and it becomes even more complex as each country has its regulations. AWS invests heavily in compliance automation to ensure the cloud adoption process remains efficient. AWS Config is a compliance automation service that offers significant benefits.

Audit Manager:
Simplify How You Assess Risk and Compliance

AWS also offers Audit Manager, a service that simplifies assessing risk and compliance with regulations and industry standards by allowing you to continually evaluate your use of AWS.

AWS Audit Manager uses AWS Config to generate compliance reports that auditors can present and may take several months to complete for large organizations. However, AWS Config and Audit Manager collaborate to streamline the assessment process and save valuable time, delivering compliance reports more efficiently.

Continuous Compliance Through Policy as Code and Compliance as Code

Using policy as code enables organizations to achieve continuous compliance without depending on scheduled audits or checks. This approach involves regular assessments for organizations to detect the impact of any changes made promptly. As a result, companies develop solutions with compliance factors considered from the beginning of the development process. Organizations can establish a more effective compliance framework by shifting compliance to the left and away from the final stages of product development.

On the bright side, the healthcare industry can benefit significantly from implementing automated checks at a scale. This can reduce the time spent on audits and shift compliance considerations to the beginning of the development process. Companies can establish a more efficient compliance framework by performing constant audit checks as early as possible. This approach also enables organizations to identify compliance issues in real time and make necessary adjustments without disrupting the development process. Implementing automated checks at scale can help businesses streamline their compliance efforts and focus on delivering high-quality healthcare services.

Conclusion

A left shift approach with AWS Config and Audit Manager identifies potential compliance issues before they escalate, streamlining the compliance process. By adopting AWS Config methodologies, organizations can enhance their cloud presence, streamline compliance, and harness the cloud's potential.

Safeguarding Your Medical Organization:
How to Detect PHI Leakages Using AWS Services

In today's digital age, protecting sensitive patient information is paramount for medical organizations. When we seek medical care, our primary focus is on our well-being. We trust doctors to help us recover, expecting our private health data to remain confidential and secure, free from any potential exploitation.

Considering Transitioning to a New EHR System?
Here is What You Should Know

Healthcare facilities, whether hospitals or doctor's offices, have evolved into intricate ecosystems. They now resemble IT companies, employing technology experts who implement and manage technologies while prioritizing HIPAA compliance, especially in safeguarding Protected Health Information (PHI). To combat the severe consequences of unauthorized PHI disclosure, medical organizations must adopt robust tools and technologies.

Dangers of PHI Leakage

HIPAA sets the standard for protecting PHI and outlines regulations that healthcare providers must adhere to.

PHI leakage occurs when protected patient information is disclosed or accessed by unauthorized individuals or systems, with consequences extending far beyond patients and healthcare organizations:

• **Legal and Financial Consequences:** Medical organizations can face substantial penalties and fines for non-compliance with HIPAA regulations. Moreover, lawsuits resulting from PHI leakage can lead to expensive legal battles and damage the organization's financial stability.

• **Reputational Damage:** PHI leakage erodes patient trust and damages the reputation of healthcare organizations, significantly affecting patient retention
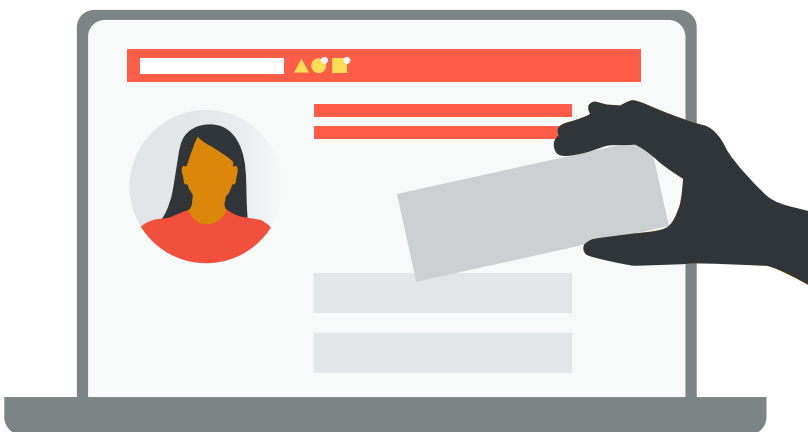
and acquisition, and hindering the overall growth and success of the organization.

 • **Identity Theft and Fraud:** PHI leakage exposes patients to the risk of identity theft and fraudulent activities, with cybercriminals exploiting stolen health information for malicious purposes.

HIPAA Violations

HIPAA violations are categorized into different tiers, each corresponding to the severity of neglect:

 • **Tier 1:** Unaware violation, not reasonably avoidable, with fines ranging from $100 to $50,000 per violation.

 • **Tier 2:** Violation should have been avoided but couldn't, even with reasonable care (excluding willful neglect), with fines from $1,000 to $50,000 per violation.

 • **Tier 3:** Willful neglect violation with corrective efforts, entailing fines from $10,000 to $50,000 per violation.

 • **Tier 4:** Willful neglect violation without correction within 30 days, leading to a minimum fine of $50,000 per violation.

Correct PHI management is crucial to preventing these penalties, with AWS offering services to help organizations identify PHI handling.

Ensuring Data Security: Exploring Background PHI Detection with AWS Macie

AWS provides the Macie service to detect PHI leakages within your organization. Leveraging machine learning algorithms, Macie analyzes and classifies sensitive data, including PHI, across various AWS resources, such as **Amazon S3 buckets.**

Macie's capabilities include:

 • **Automated Discovery:** Macie automatically scans your AWS environment to recognize potential PHI storage locations, identifying data in various formats, including text, images, and scanned documents.

 • **Data Classification:** Using natural language processing (NLP), Macie understands and classifies document content, identifying PHI elements such as names, addresses, social security numbers, and medical records.

 • **Contextual Insights:** Beyond primary classification, Macie provides context and

insights into detected PHI, aiding in assessing the severity and potential associated risks.

  • **Alerts and Notifications:** Macie generates alerts and notifications when potential PHI leaks are detected, enabling immediate action and investigations.

While Macie significantly enhances PHI detection, it operates on data stored within S3 buckets, offering both advantages and disadvantages (Fig.6):

Fig.6

Main Advantages	Main Disadvantages
• Automatic PHI discovery • Ability to configure scheduled jobs • Sophisticated discovery methods using pattern matching and ML • Support of custom data identifiers • Works with a vast variety of text-based formats • Generates detailed reports with informative statistics	• Works only with S3 storage • Not a real-time detection • Not supporting pictures

Near Real-Time PHI Detection - AWS Comprehend Medical

In addition to Macie's background detection, AWS Comprehend Medical offers near real-time analysis and detection of PHI within unstructured text. Designed for healthcare applications, it seamlessly integrates into your existing systems, providing several benefits:

  • **PHI Extraction:** Comprehend Medical employs advanced machine learning models to extract relevant medical information from unstructured text, such as clinical notes, medical records, and research papers.

  • **Entity and Relationship Extraction:** The service identifies medical entities (e.g., medications, procedures, and diagnoses) and their relationships, enabling a comprehensive understanding of the patient's health history.

  • **ICD-10 Code Extraction:** Comprehend Medical automatically extracts International Classification of Diseases (ICD-10) codes, simplifying medical coding processes and improving accuracy.

  • **Custom Entity Extraction:** You can train Comprehend Medical to recognize custom entities specific to your organization, allowing the identification of proprietary medical terms, abbreviations, or local jargon.

  • **Real-Time Analysis:** By integrating Comprehend Medical into your systems, you

can perform near real-time analysis of incoming text data, such as patient emails, chat transcripts, and social media interactions, ensuring immediate detection of potential PHI leakages.

Conclusion

Protecting PHI is a critical responsibility for medical organizations. By leveraging AWS services like Macie and Comprehend Medical, you can significantly enhance your ability to detect and prevent PHI leakages, ensuring patient information's security and privacy.

Case Studies

30% More Patients with AWS-Powered WFM Suite

CLIENT

Doc Abode is a UK-based health technology company that develops innovative digital solutions to support the NHS workforce. By matching patients' complex needs to available workers and resources, Doc Abode is using interoperable modules to transform healthcare delivery.

BUSINESS CHALLENGE

Doc Abode was engaged by its existing partners in the NHS to develop a new Dynamic Scheduling module to support unplanned care (that is urgent and emergency healthcare that is not scheduled activity) in its community.

Due to a lack of adequate products on the market, Doc Abode's partners heavily relied on text messaging, phone calls, Excel, and Microsoft Teams to match their patients' needs to the right members of their workforce, who were already busy managing their day-to-day workloads. Following the successful launches of their On-Demand and Vaccine modules, which focused on making services more efficient at several partner organizations, Doc Abode was asked to develop a custom application that would:

- **Reduce double-keying of patient information across systems**: Staff typically operate multiple systems to document patients' needs, schedule visits, and document treatment outcomes. As many of these systems are not integrated, clinical staff spend a significant part of their time re-entering the same or similar information in multiple places.

- **Optimize the use of scarce capacity and skills in the face of growing demand:** Traditional healthcare providers like GPs and hospitals have been augmented with new service models such as Urgent Community Care, Virtual Wards, and Hospital at Home to care for patients in community settings, rather than clinical ones. The goal of this program is to prevent hospital admissions, discharge patients more efficiently from hospitals to free up beds, and provide continuous care to the community. However, the size of the workforce supporting these models has not kept up with the growth in demand.

- **Provide real-time updates on staff whereabouts and caseload progression:** While live tracking and status updates are common features for takeaway, parcel delivery, or transport companies, yet in healthcare, scheduling shifts for their workforce still largely operates "offline," receiving updates when the staff returns to base at the end of their shifts. This means that when an urgent, incoming patient request is received, opera-

tors need to call up colleagues to get a sense of capacity before communicating changes in plans via follow-up calls or text messages, which is inefficient.

   • **Improve both patients and staff safety:** Doc Abode's clients work in the community and often alone. They do not have the safety of colleagues or formal settings like hospitals or GP practices to keep them safe or support them if a patient is in distress.

SOLUTION

Doc Abode first engaged DataArt during the inception of its Dynamic Scheduling module to provide business analysis (BA) and development services.

DataArt's BA observed the existing business processes of Doc Abode's partners for accepting new patients, matching patients and staff, scheduling initial and ongoing care, and dealing with capacity constraints. DataArt and Doc Abode's technical teams jointly designed a system to digitize a significant part of these processes by:

   • **Parsing information from EMR and integrating with NHS Digital's Personal Demographics Service ("PDS") to minimize the double-keying of patient details** Instead of manually retyping information already held in EMR, Doc Abode allows staff to paste the content of exported EMR data into a parser, which looks out for key markers and extracts relevant patient information. In addition, the integration with PDS allows staff to bypass EMR entirely, simply pulling patient information from the national data set based on the patient's NHS number. Then, staff only need to confirm patients' registered contact numbers and address details, reducing the overall effort to seconds.

   • **Building interactive dashboards to show the caseload and allow easier planning** Coordinators have been given access to a Web Portal, which visualizes the total demand for a service in different ways, such as timelines, list views, and a map of all patient visits. Each of these dashboards shows live status information based on updates sent by staff in the field via the Doc Abode mobile app. For example, when they toggle themselves "on duty" (staff appear as dots on the Map) or when they progress their patient visit (jobs categorized as "en route," "arrived," or "completed").

   • **Introducing algorithms to evaluate patient preferences and staff demographics with intelligent warnings to allow the optimal allocation of staff** Patients may have a preference to be visited by certain genders or (in the future) have other preferences related to pet ownership or smoking status. It is also possible that patients are not native English speakers. To provide optimal care, the system evaluates staff demographics at the time of assignment, informing coordinators if the allocated

staff member is not a good fit for the patient or if staff-patient compatibility is in doubt because demographic information is missing. Proactively avoiding a mismatch helps healthcare professionals provide the best possible care experience for their patients.

- **Leveraging iOS and Android's built-in SOS Emergency capabilities to more quickly and efficiently highlight staff emergencies**

For years, Android and Google have offered SOS capability, which can be used to inform emergency contacts of problems with the click of a button. Doc Abode provides each of its partner organizations with a dedicated phone number to use in case of emergencies. When staff trigger an SOS, Doc Abode receives the alert, parses the information, and prominently shows that a staff member is in an emergency, e.g., by highlighting their swimlane on the timeline, highlighting all their jobs on the list view, or visually flagging the staff on the Map view.

OUR SOLUTION'S KEY AWS SERVICES

- **AWS Lambda:** This service was applied to make a highly scalable solution for handling sudden increases or decreases in traffic, guaranteeing manual infrastructure management to handle such changes. Lambdas are easily integrated with other services, making this solution a powerful tool for building serverless applications that utilize various AWS services. AWS Lambda is also an extremely cost-effective option for running services.

- **AWS RDS:** This service was chosen to scale database instances vertically or horizontally, meeting the application's growing demands. Moreover, there is also a possibility to use point-in-time recovery to restore a database to a specific date, as well as multi-AZ deployment for disaster recovery.

- **AWS Dynamo-DB:** This service enabled changing the schema according to set requirements, without the need for additional server maintenance.

- **AWS Cognito:** This service was used for user authentication and authorization to securely access application resources. There was the possibility of creating a "user pool," a directory for users that enables registration and signing in. Using identity and access management (IAM) roles and policies, the team was able to manage access to application resources. Cognito provides a comprehensive set of monitoring and logging tools that help monitor user activity and security.

- **AWS S3:** This service allowed the storage of various unstructured data. It creates a flexible security system that helps control access to objects using bucket and object-level policies alongside high availability, scalability, and reliability.

RESULTS AND BENEFITS

After the successful deployment of Doc Abode's Dynamic Scheduling module, Doc Abode's partners have seen substantial improvement in their use of resources and the quality of care provided to patients, including:

- The administrative effort to coordinate schedule changes has been eliminated due to real-time communication between the base Controller interface and Mobile push notifications to community users.

- After-care for patients has been streamlined as staff in the community can easily leave comments on completed jobs and self-book follow-up work for patients, reducing the time of administrative handovers.

- Doc Abode's real-time scheduling capabilities have improved patient outcomes and significantly reduced costs.

- Services are seeing approximately 30% more patients due to the ability to see and react to spare capacity, thanks to our software's real-time job.

Case Studies

GenAI ChatEnabled Document Search for Efficient Patient Support

CLIENT

A US-based healthcare organization has a custom internal platform (Care Management Platform—CMP) that tracks and manages patient care data and provides company operators with information needed for patient guidance and patient request processing from the document database.

CHALLENGE

CMP operators must consistently reference documents guiding operators through patient management. However, the complexity, volume, and variety of the information formats within the CMP made it difficult for operators to quickly find and utilize relevant data, impacting decision-making and real-time operational efficiency.

The client needed a solution that allows quick finding and referring to the necessary documents with high accuracy and enables operators to ask natural language questions (not using any templates) without generating responses but providing source documents with relevant information.

SOLUTION

To address the challenge, DataArt's team has created a Generative AI chatbot-style solution leveraging AWS Bedrock for LLM and AWS Kendra for knowledge management. It operates as a conversational tool that allows operators to ask natural language questions and get precise answers referring to the source documents (operators also view contextual information, which can be added if needed).

The main challenge was to keep the chatbot within the request context, provide relevant answers, and avoid solution hallucinations—prompt guardrails were added, and the chatbot was tested using irrelevant questions as a part of a responsible AI implementation strategy. Also, the assistant's personality was fine-tuned, and the answers were edited to sound human-friendly and present a helpful and professional personality.

Technologies:

- AWS Bedrock
- AWS Kendra
- AWS ECS
- AWS ECR
- LangChain

OUTCOMES

• DataArt designed a GenAI conversational chatbot-like solution integrated directly into a CMP.

• The solution provides real-time support for the CMP operators who can ask natural language questions.

• Query processing time was reduced by up to 30% - operators' efficiency increased.

• 90% accuracy score (for the references matching the request).

• The solution features auto-scaling capabilities, which allow it to manage an unlimited number of queries, adapting effortlessly to increased demand.

• The intuitive AI tool simplifies the training process for new CMP operators, enabling quicker onboarding and proficiency.

Case Studies

Accelerating Tuberculosis Research and Diagnostics with FIND's AWS-Enabled Knowledge Base

EXECUTIVE SUMMARY

FIND has designed an information-sharing knowledge base platform that connects laboratories, research institutions, clinicians, and public health programs worldwide, fostering collaboration and streamlining the journey to improve drug-resistant tuberculosis (DR-TB) diagnostics. The client selected DataArt as a trusted partner for website development, bioinformatics analysis, and Stats Modules development, as well as for ensuring AWS compliance with security guidelines. This collaboration is set to accelerate the pursuit of breakthroughs in DR-TB diagnosis, thus fulfilling FIND's vision of a healthier world for all.

SOLUTION HIGHLIGHTS: UNLOCKING THE CODE TO BETTER HEALTHCARE

DataArt streamlined the diagnostic journey with an innovative, multi-tiered approach. With Amazon Web Services (AWS) serving as the backbone of the solution, the following key components were addressed:

- **Integration of Public Data Sources: Refined the ETL logic using a public API of the reference International Nucleotide Sequence Database Collaboration**

- **Bioinformatics Analysis Optimization: Conducted thorough testing and adjustments of the heavy ETL pipeline for sequencing data extraction**

- **AWS Step Functions Enhancement: Updated State Machines workflows to enable smooth and automated computing with AWS Batch.**

- **AWS Configurations: Ensured compliance with security standards.**

- **AWS Lambda and Fargate Management: Assisted the client in adjusting AWS Lambda and leveraged Fargate to enhance website security and scalability.**

- **AWS ECS and AWS Cloudfront: Created a new data visualization web portal and deployed it using AWS services in a scalable and reliable way.**

Please reach out to DataArt at healthcare.coordination@dataart.com or visit our **Healthcare & Life Sciences and AWS page.**

Our Offerings for Healthcare & Life Sciences on AWS

Business Use Case Offerings

Digital Health

- Digital health and therapeutics (incl. DiGA and DiPA)
- Patient portals
- Patient health records
- Mobile health and treatment
- Personalized medicine

Medical Devices

- Remote patient monitoring
- Medical devices and wearables
- Data capturing
- Mobile health
- Patient engagement

Payers Experience

- Insurance claims
- Processing and billing
- Integration payments between clearing house and patients
- Claim scrubbing

EHR, EMR, LIMS

- Custom development and integration of Electronic Health Records (EHRs)
- Hospital digitization solutions
- Laboratory information systems

Medical Imaging

- Radiological data processing
- Preparation for surgery
- Implant 3D models
- Analysis of AI/ML results

Clinical Trials

- Pre-clinical trials and development of lab informatics systems
- Decentralized clinical studies
- Trial optimization

Foundation Offerings

Assessment and Migration Planning

- Migration design, planning, and execution
- From quick PoCs to production workloads
- Cloud coaching sessions

Cloud-Native Processes and Practices

- DevOps, CI/CD, IaC, HA/DR
- Audit infrastructure and application security

Cloud Enablement Services

- Cloud migration
- Application modernization
- Cloud-native design and development

Cloud Cost Optimization

- Rightsizing
- Cloud-optimized design
- Resource monitoring
- Selection of AWS services

Cloud Native Software Engineering

- Microservices and declarative APIs
- Resilient, scalable, and observable applications
- Containers, orchestrators, and serverless computing

No Platform Lock-In

- Design various cross-cloud and cloud agnostics scenarios

Why DataArt

DataArt is a leading software engineering firm and the partner for progress in the digital age. Guided by our people-first principle, our world-class team designs and engineers data-driven, cloud-native solutions that generate immediate and enduring business value. Through our 20+ domain Labs dedicated to R&D and strategic innovation, we work together with our clients to ensure they stay on the leading edge.

5,000+ professionals   **26** years in operation   **30%** of our engineers
have healthcare-related experience

20+ countries   **30+** locations

DataArt Healthcare & Life Sciences Practice & AWS

18+ years in Healthcare & Life Sciences industry

36% 5-year CAGR

150+ healthcare clients

95% return clients

150+ completed projects on AWS

30+ healthcare clients using AWS

With our partners, we offer innovative approaches in nearshore and offshore healthcare software development, reducing cost and complexity while improving health outcomes.

The team has extensive knowledge of the healthcare industry, accumulated over 18 years of experience in the US, UK, and continental European markets.

DataArt's healthcare team (420+ engineers) concentrates on the latest advancements in technology—i.e., AI, Machine Learning, VR, and IoT—and how these advancements can be applied within the industry.

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