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Data Preparation Challenges in Healthcare and Voracity from IRI

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As in any market sector or industry, the explosion of data volumes is an obvious, and ongoing challenge. But healthcare has some unusual, if not unique challenges. One is organisational. In order to deliver patient centred outcomes, data needs to be collected from multiple different organisations covering primary, secondary, tertiary and social care. The other major issue is the political and social sensitivity about the sharing of patient data.

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Introduction

s a patient, you are often required to repeat the same information to different medical practitioners on each stage of your patient journey. You could be forgiven for wondering if any of the information you give medical practitioners is ever captured and shared effectively. Yet that data, collected in great volume, combined with new sources of data from, for example, connected medical devices is critical in driving better patient outcomes and improving the overall efficiency and effectiveness of the healthcare system.

In this paper we will look at the challenges healthcare organisations face in ensuring that the data they collect is accessible, secure and of a quality that enables it to be used in a timely and flexible fashion for a diverse array of use cases to improve patient experience, optimise internal processes and meet regulatory requirements. We will discuss the key data preparation tasks and point to the type of solutions that should be considered.

In the context of these challenges, we will highlight the Voracity data management platform and how well it tackles the technical challenges of discovering, integrating and migrating data so that it meets all regulatory needs and provides a sound and secure foundation for providing data driven improvements in health outcomes and system productivity.

The Healthcare Environment

Since the end of the Second World War in 1945, expenditure on healthcare, as a percentage of Gross Domestic Product (GDP) in all the industrialised economies has risen inexorably year on year. For example, **spending on healthcare** in the United States reached 16.8% of GDP in 2019 while in the United Kingdom the figure was 10.2%. There are a host of reasons for this, but two drivers stand out in particular. Firstly, tremendous advances in medical science mean that many more diseases and health conditions can be treated, resulting in a significant increase in medical interventions. Secondly, and partly as a result of the first driver, most mature industrialised economies have an increasingly large elderly population. Studies about the UK National Health Services (NHS) show that people over the age of 65, who *represent 18%* of the total population, account for *40% of healthcare costs*. Falling birth rates and people living longer means that the cost pressures of an ageing population are not likely to ease any time soon.

The Importance of Data

The Covid 19 pandemic brought the importance of data into sharp relief. While data scientists found themselves the uncomfortable focus of attention early in the pandemic, their role and the availability of relevant and timely data in both supporting the rapid development of new vaccines, and helping overstretched hospital emergency departments plan and prepare for surges in infections from a virus that kept on mutating was absolutely crucial. As with many other business sectors huge volumes of data are collected every day from patient consultations, medical procedures, hospital stays and connected medical devices as well as data from social care settings.

There has also been a growing realisation that, in order to continue to improve health outcomes, overall efficiency and patient experience, patients need to be placed at the heart of the system. Now there is constant messaging around healthcare needing to be "patient centred" and "understanding the patient journey". To do that effectively, you need accurate, timely data from a number of different sources. As we will see in the next section, this is far from straightforward.

Data Management Challenges

As in any market sector or industry, the explosion of data volumes is an obvious, and ongoing challenge. But healthcare has some unusual, if not ...the UK National Health Services (NHS) show that people over the age of 65, who represent 18% of the total population, account for 40% of healthcare costs.

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unique challenges. One is organisational. In order to deliver patient centred outcomes, data needs to be collected from multiple different organisations covering primary, secondary, tertiary and social care. The other major issue is the political and social sensitivity about the sharing of patient data. Business managers are aware of this. However, they are less likely to understand the challenges and complexities of getting that data in a state that enables analytics to be able to deliver the patient insights they crave to deliver better health outcomes while controlling operational costs.

Time-consuming data preparation tasks

In a recent Anaconda State of Data Science Report, survey responses from 2,360 data professionals identified that over 45% of data scientists' time was spent on data preparation and cleansing tasks that take valuable time away from real data science work. So, what is involved?

Data discovery, finding out where all your data is, is the first task. This sounds simple, but over time data from different sources has been stored in separate, siloed databases and, particularly in healthcare, in spreadsheets. Given the amount of data and the variety of sources, many organisations don't know, easily, where all their data is. The time and money spent trying to track down all their data sources slows business processes and data insights, increases data storage costs, and undermines the ability to drive meaningful productivity improvements.

Next, the source data has to be profiled to understand its structure, content and interrelations, as well as its quality – which covers its accuracy, completeness, consistency, timeliness and accessibility.

This is followed by extracting the data you want from the primary source, transforming it into a format compatible with the structure of your data warehouse or data lake, and then loading the data to the target environment(s).

Finally, Data Enrichment; this refers to enhancing existing information by supplementing missing or incomplete data with relevant context obtained from additional sources. In other words, it is the process of improving, refining, and augmenting raw data.

Regulatory Compliance and Data Privacy

Thorough data preparation forms an essential grounding for easier compliance with a growing range of data security and data privacy regulations. However, in healthcare the protection of Personally Identifiable Information (PII) has become increasingly important in recent years. In the United States, the Health Insurance Portability and Accountability Act (HIPAA) provides very specific legally enforceable rules around patient information. In the European Union, the General Data Protection Regulation (GDPR), and in the United Kingdom the Data Protection Act, are the main regulatory compliance laws. But as these are more general than HIPAA, a range of policies have been put in place, such as the Caldicott Guardian in the NHS, to ensure specific healthcare data privacy and security issues relating to patient data are adhered to.

Healthcare organisations hold significant volumes of patient information that can only be used for analytics purposes so long as the patients' PII (also referred to as Protected Health Information or PHI) is not revealed. The ability to quickly and comprehensively mask PHI so that patient data becomes anonymised is now a critical requirement.

As a healthcare provider, whether you are interested in analytics, in providing self-service data access, in machine learning, cloud migrations, or regulatory compliance, data management in general, and data preparation in particular, data governance is a necessity. Data preparation tasks are labour-intensive, and data quality is often inadequate. Data accuracy can be compromised, data lineage is often unavailable, and data often does not reflect the latest version of data objects in production systems.

The way forward

Historically, these data preparation processes have relied on a stack of tools, often unintegrated and reliant upon different vendors to handle the various data preparation tasks. Now, modern data management platforms offer more comprehensive and integrated solutions. Data Management covers a much wider area than the data preparation tasks we have discussed here, so having a data management platform that has excellent data preparation and governance capabilities that can be acquired and implemented separately might be an important consideration.

Given that many healthcare organisations will already have well established analytics, business intelligence, data pipelines, data warehouses, data lakes and other data tools, it is important to look for solutions that provide ease of integration into existing environments.

Implementing a modern data management platform that reduces the manual data preparation workload, improves data quality, masks PII, and simplifies the process of getting data analytics and regulatory compliance ready will promote innovation and help healthcare organisations navigate their ever changing clinical, social, technology and regulatory environments.

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Solution: Voracity from IRI

What is Voracity?

Powered by CoSort (or Hadoop), and built on Eclipse, *IRI Voracity* is a multi-purpose data management platform designed to perform, speed, and consolidate common work in five general areas:

1. Data Discovery –

data profiling, classification, search, and metadata redefinition

2. Data Integration -

high volume ETL, change data capture, slowly changing dimensions

3. Data Migration –

file/data/database type conversion, replication, and federation

4. Data Governance –

data quality, PII/PHI masking, re-ID risk scoring, test data synthesis

5. Analytics -

embedded BI, tie ups to Datadog, Excel, KNIME and Splunk, wrangling for the rest As can be seen in *Figure 1*, Voracity drives solution depth by supporting critical data movement and manipulation requirements – and combining many of these tasks in one job and I/O pass – for a wide variety of data sources and targets.

What Does Voracity Do?

IRI CoSort is the default Voracity data integration engine. Unlike other such products, it is not confined to ETL (extract, transform and load) operations but also supports batch and real-timedata replication (change data capture), federation, masking, cleansing, and reporting. Another key point to note about it is that Voracity jobs need not transform data in separate steps. You can define jobs that way, but at run time the engine consolidates multiple steps to reduce I/O. Added to the fact that the CoSort run-time engine uses a 2MB, multi-threaded C executable (called SortCL) and loads only the libraries it



Figure 1 – IRI Solutions requires, and you will appreciate why CoSort has a performance advantage over its competitors.

Note that IRI also offers a Hadoopbased option that does not have the same footprint advantages of CoSort but can often otherwise run in a similar fashion because many jobs developed for native CoSort implementations work without change in Map Reduce 2, Spark, Spark Streams, Storm or Tez. Dataflows are actually stored in files and can be executed from anywhere.

The company offers an extensive range of native connectors for data, including files in Excel, healthcare transaction and image file formats, MQTT and Kafka messages), cloud stores, and relational and NoSQL databases Not surprisingly given its heritage, it also supports mainframe sources that use COBOL copybooks, EBCDIC and so on. While it does not run on z/OS, it does support mainframe databases as sources and will itself run on z/Linux.

While IRI Voracity does not offer a module called "data quality", it does front-end several data quality rules, and provides substantial relevant capability in SortCL jobs, as illustrated in *Figure 2*.

A major strength of IRI Voracity is clearly in its Data Protector Suite. To begin with, IRI has deployed machine learning within IRI DarkShield to support the identification of sensitive data (and we are anticipating that M/L will be implemented more widely across the platform). It also uses natural language processing for this purpose.

Once PII is discovered, as mentioned, the company offers significant capabilities when it comes to masking. In particular, dynamic data masking may be proxy-based, run in situ or driven by APIs, and can be mixed and matched with static masking. DarkShield in Voracity supports the ability to search, parse and protect multiple sources containing semi- and unstructured data with consistent masking functions to support enterprise data integrity, as illustrated in *Figure 3*. This is especially important in healthcare, where DarkShield can de-identify PHI in HL7 and X12 EDI files as well as DICOM studies.

Finally, given the current predilection for companies to migrate from on-premises data warehouses to cloud-native data warehouses such as Snowflake or Google BigQuery, it is worth noting the availability of IRI FACT, IRI NextForm, and IRI Ripcurrent, which Voracity supports to bolster high volume database migrations using batch or real-time data mapping.

- Figure 2 Data quality functions in IRI Voracity



Figure 3 – DarkShield in Voracity



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Voracity delivers all of its functionality at speed and at volume, enterprise-wide and at enterprise-scale, which should go a long way in reducing the amount of time spent on data preparation.



Why should you care?

s a data management platform, one of Voracity's key strengths is its ability to not just deliver all of the functionality we've described above, but to deliver it within a unified, centralised, integrated platform supported by a common engine. Platform solutions in general are measured by how well they achieve this after all, without this sort of cohesion they are just a collection of products and we are pleased to say that IRI does not disappoint. Voracity delivers all of its functionality at speed and at volume, enterprise-wide and at enterprise-scale, which should go a long way in reducing the amount of time spent on data preparation.

That said, it is clear that data integration and transformation lie at the heart of the platform, largely owing to IRI CoSort and its 45-year lineage. What's more, technologies of this type might as well be essential for building data lakes and data warehouses, performing analytics, moving data out of legacy tools or into the cloud, and accomplishing the vast majority of whatever other data manipulation initiatives you can think of. Thence IRI is well-positioned to address all of these various use cases while operating at big data scale and speed.

In addition, functions like cleansing, masking and wrangling can be performed in combination, achieving multiple positive outcomes with only one pass over the data. Moreover, the IRI Workbench acts as something of a central hub, and a common graphical user interface, for actioning almost any particular task within Voracity. Although perhaps it is not the flashiest tool, it is extremely well suited for its intended purpose of providing developers and data engineers with a single point of entry to a wide range of IRI functionality. When seen from this perspective, we would consider it a significant and notable win for developer and data engineer ease of use and productivity.

On the other hand, it is much more advanced when it comes to ETL performance and sensitive data protection than many of its competitors. The company's data migration capabilities will also be a boon in the current environment, as will its relatively attractive price points and licensing options.

The Bottom Line

he key features of IRI Voracity are the performance that the CoSort engine offers, and the depth of capability it provides in extending its data management platform into the identification and management of sensitive data. If these are important issues for you, then you should seriously consider IRI Voracity.

The long and the short of it is that Voracity is well-positioned as a holistic platform for healthcare and biopharma data management with particular strengths in data integration and masking.

FURTHER INFORMATION Further information about this subject is available from *www.bloorresearch.com*



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About the author PAUL BEVAN Navigator, Research Director: IT Infrastructure

aul has had a 40-year career in industry that started in logistics with a variety of operational management roles. For the last 33 years he has worked in the IT industry, mostly in sales and marketing, covering everything from mainframes to personal computers, development tools to specific industry applications, IT services and outsourcing. In the last few years he has been a keen commentator and analyst of the data centre and cloud world. Until recently he was also a nonexecutive director in an NHS Clinical Commissioning Group.

Paul has a deep knowledge and understanding about the IT services market and is particularly interested in the impact of Cloud, Software Defined infrastructure, OpenStack, the Open Compute Project and new data centre models on both business users and IT vendors. His mix of business and IT experience, allied to a passionate belief in customer focus and "grown-up" marketing, has given him a particular capability in understanding and articulating the business benefits of technology. This enables him to advise businesses on the impact and benefits of particular technologies and services, and to help IT vendors position and promote their offerings more effectively.

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