

# Healthcare Business Intelligence: A Primer

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## ABSTRACT

To succeed in a modern digital world, healthcare industry must be data-driven.

Hospitals and healthcare institutions desire to make their workflows more efficient in order to meet demand. One way they can achieve this is with the help of business intelligence (BI) software. BI refers to the acquisition, correlation, and transformation of data into insightful and actionable information through analytics. Utilizing a BI software is an indispensable part of the growth process toward becoming data-driven. In the modern healthcare environment, almost all BI initiatives will be driven by data analytics. This paper provides a brief examination of the deployment and constraints of business intelligence in healthcare.

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## INTRODUCTION

To turn any business into a profit-making enterprise requires that the work force make wise decisions which depend on the available information. This is where business intelligence comes in. Business intelligence (BI) refers to technologies, applications, and practices for the collection, integration, analysis, and presentation of business information and also sometimes to the information itself. It is a broad term to describe a set of methods, processes, and technologies that transform raw data into meaningful and useful information to support business operation. It may also be regarded as a collection of decision support technologies for the enterprise aimed at enabling professionals make better and faster decisions. The purpose of BI is to support better business decision-making. Business Intelligence (BI) refers to technologies, applications and practices for the collection, integration, analysis, and presentation of business information and also sometimes to the information itself [1]. Business intelligence (BI) also refers to a broad category of analytics, data warehousing and visualization tools. The purpose of BI is to support better business decision-making. Although BI is designed for the business environment, it can be used by government, universities, healthcare, and security.

In the United States, healthcare is undergoing dramatic change. The industry is shifting from historical fee-for-service to fee-for-value. It is in the middle of a digital revolution with massive amounts of data generated daily. Today's healthcare practitioners are facing the demand for information to comply with legal and customer requirements. Hospitals have their data spread out and

residing in several databases in the form of clinical data, administrative data, and external data [2]. BI is considered a possible solution to these challenges. It is a term used to represent tools, techniques, and systems that are useful in making informed, better decisions. BI system is developed to support decision-making domains such as hospital management, clinical decision support, and clinical research.

## BUSINESS INTELLIGENCE CONCEPT

The concept of business intelligence (BI) refers to the tools and systems that play a major role in the planning process of an organization. The tools represent BI in customer support, customer profiling, market research, product profitability, and business analysis.

The main objective of business intelligence is to enable business managers to have easy access to data, be able to conduct analysis, allow them to convert data into useful knowledge, and then make faster, better decisions [3]. BI software supports reporting, interactive analyses, visualization, and statistical data mining. People use business intelligence for many reasons such as the need to seek improvements in decision-making and competition and the need to seek efficiency.

Different types of data analytics can help hospitals and other healthcare organizations better serve patients in several ways [4]:

- Descriptive analytics. Shows what is happening or has been happening.
- Diagnostic analytics. Points to relationships and causes like tracing heart disease back to poor diets.

- Predictive analytics. Indicates what will likely happen
- Prescriptive analytics. Recommends specific actions in response to individual patient symptoms.

BI system is an integrated set of tools, technologies and programmed products, which are used to collect, integrate, analyze and share data]. BI system has following components [5].

- *Extraction-Transformation-Load (ETL)*: ETL tools that are responsible for data transfer from operational or transaction systems to data warehouses.
- *Data Warehouse*: Data Warehouse (DW) is the core of any solid BI solution. It provides storing of aggregated and analyzed data. It allows reports to be produced at a reasonable cost for community. A good data warehouse should ensure data protection and security.
- *Data management and integration*: This component prepares data to be ready for analysis and reports. It involves analyzing, reporting, and presenting tools such as on-line analytical processing (OLAP) tools which allow users access and which analyze and model business problems and share information.
- *Presentation*: This component is a focused layer which brings sense-making and decision support directly to users. Presentation layers include customized graphical and multimedia interfaces or dashboards to provide users with information in a comfortable and accessible form.

Business specific applications require all components above to work together to realize a complete solution.

Business Intelligence (BI) is a fast growing field with significant benefits and opportunities for healthcare workers. The healthcare workers need fast, responsive, and user-friendly BI software to maximize the value of their data and support critical areas of decision making. BI tools are must-haves for any long-term and sustainable analytics foundation. Figure 1 shows a typical healthcare business intelligence [6].

#### APPLICATIONS

Interest in implementation of business intelligence (BI) technologies in different sectors has been increasing from year to year. BI is applied in various areas such as finance, retail, insurance, healthcare, etc. All these areas are entering a new era that data-driven.

Healthcare has the most complex data of any industry, both structured and unstructured data. For example, the hospital collects data from different sources such as from sensors on patient vitals, heart rate, and blood pressure, labs, pharmacy, finance, claims, billing, CRM, EMR, HMS, etc. These data can be grouped into three categories: financial, operational & clinical. Business Intelligence is needed in healthcare to manage the sheer amount of data being generated by hospitals and healthcare organizations daily. Incorporating the BI technology into deploy Electronic Health Record (EHR) and Electronic Medical Record (EMR) will improve the quality and safety of healthcare delivery [7].

As illustrated in Figure 2, applications of business intelligence in healthcare can be categorized in two major

sets of solutions: Technology solutions and business solutions [8,9].

#### A. Technology Solutions: It's Data & Information Tools and Services, as follows:

1. Decision Support Systems (DSS): Support managerial decision making, usually day-to-day tactical.
2. Executive Information Systems: Support decision making at the senior management level which provide metrics-based performance information.
3. Online Analytical Processing (OLAP): Support analysts with the capability of perform multi-dimensional analysis of data.
4. Query and Reporting Services: Provide quick and easy access to the data with predefined report design capabilities.
5. Data Mining: Examines data to discover hidden facts in databases using different techniques.
6. Operational Data Services: Collect data from end users, organizing data, establishing solid data structures and store them in multiple databases.
7. Integration Services: Design and implement of process flow of data extracting, transforming, and loading to the data warehouse.

#### B. Business Solutions: Business focused analytical applications, as follows:

1. Patient Analysis: Focuses on analysis of patients' demographic and satisfaction processes.
2. Electronic Health Record Analysis: Focuses on analysis of the quality of clinical data.
3. Performance Analysis: Streamline and optimize the way that a business uses its resources.
4. Fund Channel Analysis: Devise, implement, and evaluate fund strategies, then use the corporate metrics to continuously monitor and enhance the fund process
5. Productivity Analysis: Focuses on building business metrics for activities such as quality improvement, risk mitigation, asset management, capacity planning, etc.
6. Behavioral Analysis: Understanding and predicting trends and patterns that provides business advantage.
7. Supply Chain Analysis: Monitor, benchmark, and improve supply chain activities from materials ordering through service delivery.
8. Wait Time Analysis: Focuses on the factors that are associated with longer waiting times and the effects of delays in scheduling and operation.

#### BENEFITS

The benefits of applying BI in healthcare are tremendous. BI will help hospitals to establish best practices in both care and management. It allows organizations to build a reputation around patient and clinical care. BI adoption helps healthcare organizations manage the untapped potential of their massive amounts of data. Other benefits of using Business Intelligence in a healthcare include [1,10].

- *Decision Making*: BI accelerates and improves healthcare decision making. The faster data gathering and

meaningful analytical report production helps in decision support. They also provide high-quality data for decision making. BI systems also enable healthcare organizations to gather their data in a single repository, helping users make better decisions. They can allow decision makers to use and alter data and models in real time to support decision making.

- *Protection of Data:* Since there would be a single point access of data and access is only provided to those with appropriate access authorization.
- *Increased Profits and Reduced Costs:* The need to reduce costs across all areas of operations is becoming necessary. BI allows Healthcare providers to reduce waste and minimize the costs of healthcare specialists, lab equipment, medical materials, lab consumables, and treatment per diagnosis.
- *Enhanced Patient Care:* With BI, healthcare professionals have easy access to patient's data and can make decisions based on demographic data, sex, age, etc. Specialists can use this information to prescribe medications or encourage patients to make lifestyle adjustments to minimize their risk of disease. Timely and effective clinical decisions are better facilitated by using BI.
- *Reduction of Medical Errors:* Providing safe, quality care is a top priority for the healthcare industry. BI enables organizations to track large amounts of information and identify the most efficient practices. It also helps providers identify trends and anomalies, and analyze risk in clinical care.
- *Prediction:* Application of BI in healthcare will give healthcare practitioners the power to address the future, not just simply relying on historical data to make decisions BI software (such as data visualization tools, discovery tools) also gives them the tools necessary to make accurate predictions regarding patients. Making such prediction may require time, relevant data, sufficient information, and experience.

## CHALLENGES

Applying business intelligence to the healthcare sector faces several challenges including the following [11].

- *Lack of funds:* Adopting and shifting to such a complex technology requires a lot of initial capital. Such a complex system requires availability of equipment like server, fast computing machines, and expensive software. Some healthcare organizations are challenged by limited budgets and ineffective management.
- *Complexity of IT Equipment:* Technically, healthcare based business intelligence systems are complex to build and maintain. Healthcare organization has many complex machines e.g. one for radiology, other for XRAY etc. so combining and studying data from such complex. Healthcare organizations find it difficult to keep up fast changing technologies. It may also be difficult to segregate between relevant and irrelevant data.
- *Lack of knowledge:* Advanced technology requires the availability of the knowledgeable personnel who can help others to learn and use the technology appropriately and effectively.

- *Data Standards:* Organizations need to have a standard according to which such complex data can be structured. Interoperability is needed to allow sharing electronic health records with physicians, pharmacists, and hospitals.

## CONCLUSION

The delivery of healthcare has always been information intensive. The volume of information created, shared, and stored is growing at a rapid rate. Healthcare is changing very fast and so is the industry's need for business intelligence. One may regard BI as a new methodology to maximize the benefits for healthcare organizations. BI helps to transform raw data into smart information. North America accounts for the largest share of the healthcare business intelligence market due to increased implementation of healthcare BI solutions. The top healthcare business intelligence companies include Acmeaware, Datawatch, Epic Systems, Getwellnetwork, Inovalon, SAS, Medhost, Siemens Medical Solutions USA, and Strata Decision Technology [12].

Today, healthcare industry is under pressure to improve operational efficiency, patient care, and economic sustainability. It is growing to include not only the traditional information systems, but also a business intelligence platform. Forward-thinking healthcare companies realize that data and business intelligence play a crucial role in precise decision-making that will improve patient care. The level of involvement of business intelligence healthcare will dictate the difference between surviving and thriving in the new data-driven era. For information about healthcare business intelligence can be found in the books in [13,14] and one related journal: *Business Intelligence Journal*.

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**Figure 1 Healthcare business intelligence [6].**



Figure 2 BI applications in healthcare [8].

