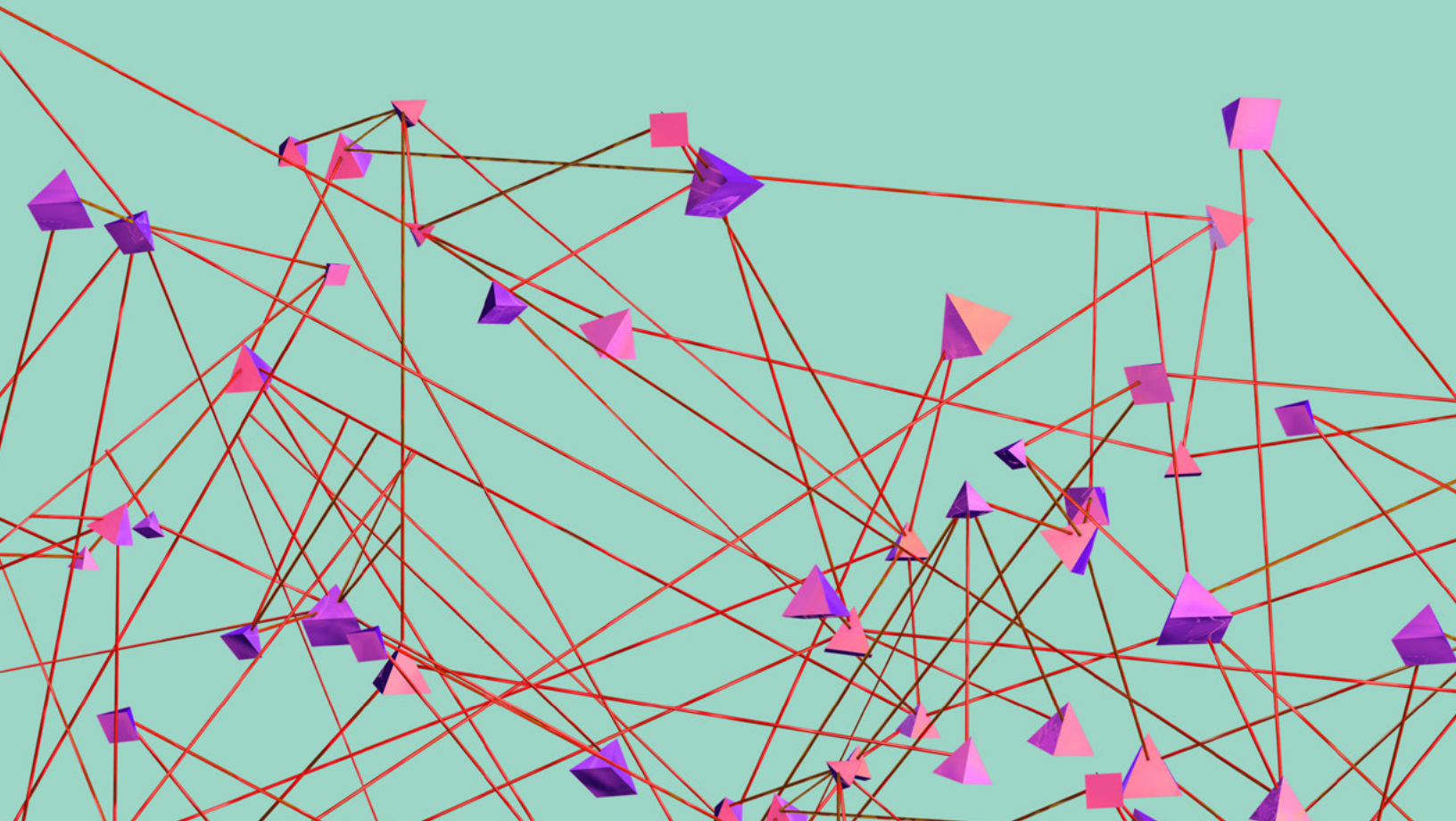


# BUSINESS ANALYSIS IN THE DATA SCIENCE AGE

**Accelerating Healthcare Innovation**



**What ails the healthcare industry? The diagnosis is clear—healthcare faces multiple challenges that have a direct impact on the lives of people across the globe. A key challenge is that while the industry has over the past few decades made huge investments in technology, their translation into better treatment options have been strikingly low. The industry is now tapping data science to glean insights from the vast amount of data it has—to make smarter, more informed decisions, while placing patients’ interests at the center.**

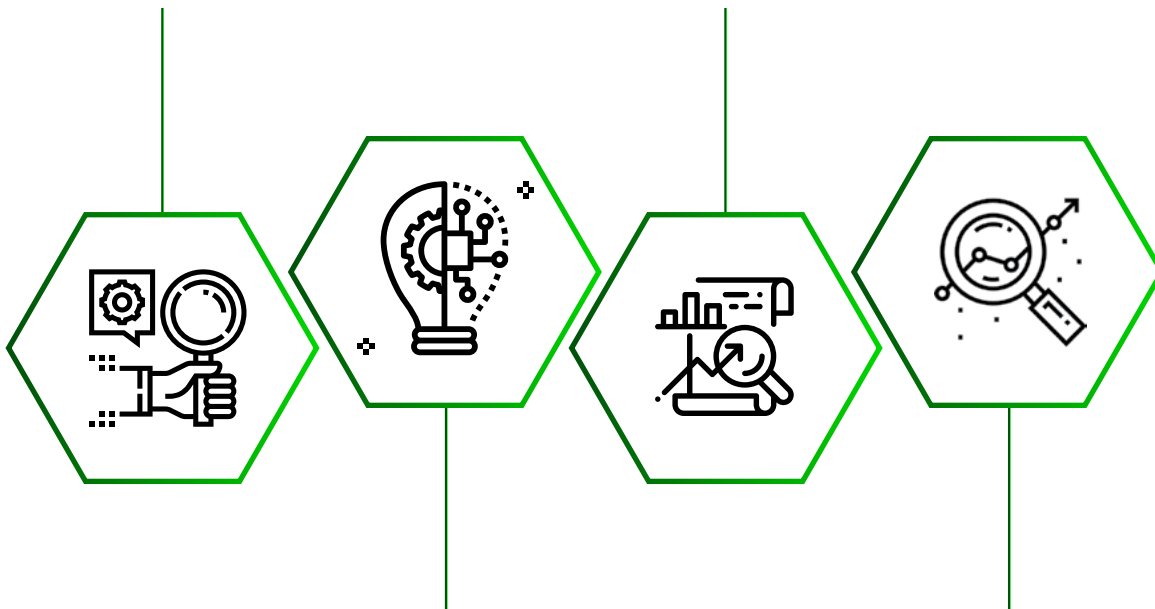
**This paper discusses how data science is enabling innovation in several areas in healthcare, including pharma, and helping drive better patient outcomes. It also explores the changing role of business analysis professionals in this age of data-driven disruption, and how they can hone and apply their skills to enable the industry’s transformation.**

# DISRUPTING WITH DATA

We live in a digital world. There is an overwhelming amount of data coming in from every computer, every mobile device, every camera, and every imaginable sensor. Data is growing at a rate of nearly 40 percent per year<sup>1</sup>. Companies realize that data has immense potential to unlock growth. Indeed, companies across industries are exploring ways of extracting insights from data to drive productivity and growth. They are leveraging data science to:

Obtain predictive, actionable insights.

Communicate relevant business stories from data.



Help make faster, smarter decisions that drive business value.

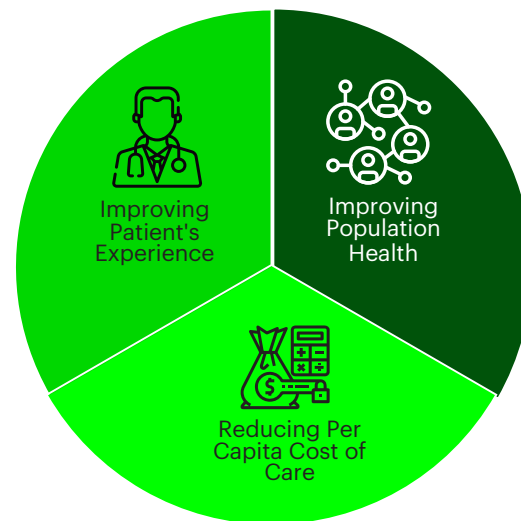
Discover the unknown—the previously hidden insights.

# HEALTHCARE: BETTING BIG ON TECHNOLOGY

The healthcare ecosystem is a holistic network of providers, payers, pharmaceutical companies, government agencies, medical device companies, NGOs, IT service providers, and, of course, patients.

Like other industries, healthcare is on the path of innovation. It is leveraging emerging technologies to improve patient experience and drive better patient care. Organizations like the Institute for Healthcare Improvement (IHI) has created a framework called the “Triple Aim,” which provides a systematic approach to optimizing the health system performance<sup>2</sup>. The three aims are improving the patient’s experience of care, improving the health of populations, and reducing the per capita cost of healthcare (see Figure 1).

Figure 1. Realizing the Triple Aim: Efforts include an estimated investment of \$25 billion in the last five years in IT alone.



The industry has been working to realize the Triple Aim. It is estimated to have invested a whopping \$25 billion in the last five years in IT alone<sup>3</sup> in the hopes of reducing medical errors, decreasing healthcare costs, and improving patient outcomes. While the results have not been very promising, partly due to the sheer complexity of healthcare, the investment has resulted in the rapid expansion of electronic medical records (EMRs)—they have gone up from 15.6 percent of all health records in 2010 to more than 75 percent in 2018, thus contributing to the growing data reservoir in healthcare<sup>4</sup>.

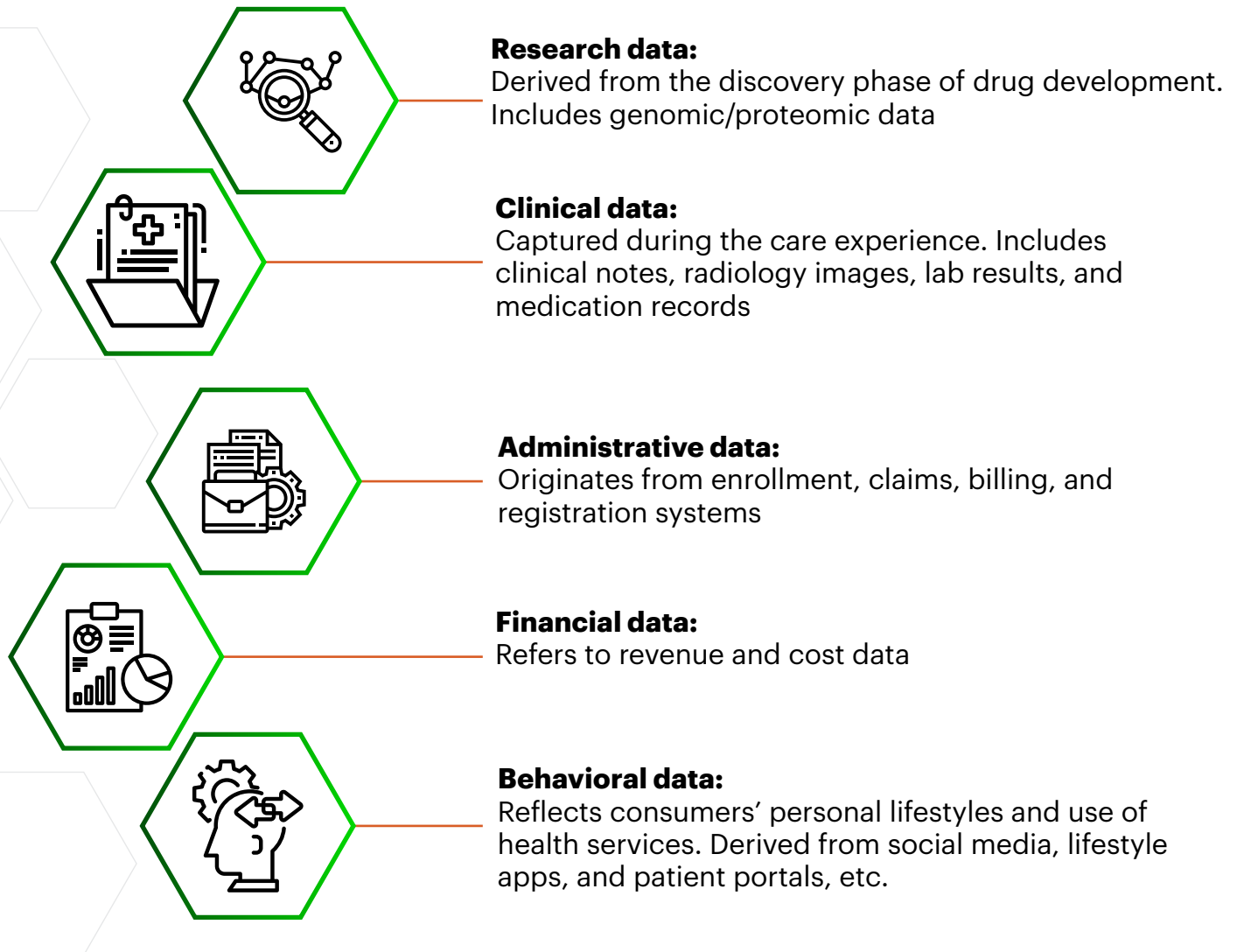
# HEALTHCARE DATA: IT'S A COMPLEX WORLD

According to Winston Hide of the Harvard School of Public Health, “In the last five years, more scientific data has been generated than in the entire history of mankind.”

Though industry players such as hospitals, payers, and pharma were among the last to embrace the IT revolution, a decade of digitization has resulted in an exponential increase in the volume, velocity, variety, and veracity—sometimes called the 4Vs—of healthcare data.

**Indeed, healthcare is churning out data at the rate of 48 percent per year. That’s approximately 30 percent of the world’s data production<sup>5</sup>. There is abundant health data amassed from numerous sources including electronic health records (EHRs), genomic sequencing, payer records, pharmaceutical research, wearables, medical devices, and so on.**

## CLASSIFICATION OF HEALTHCARE DATA



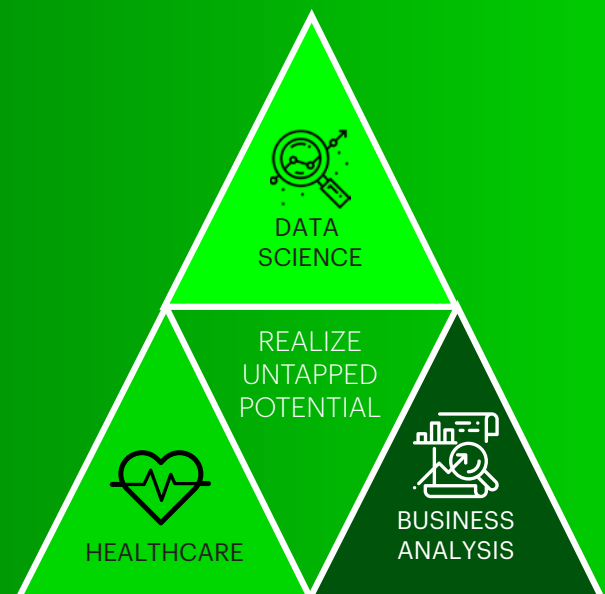
Adding to the complexity is the type and form in which these data are generated. Nearly 80 percent is unstructured data including written doctors' notes, scanned documents, images, and other free-form files. This kind of data is notoriously difficult to use because unlike structured data that is easy to view and use, this data is unorganized, text-heavy and not easily processed. Because of the diversity—in format, type, and context—it is difficult to merge healthcare data into conventional databases. Hence the enormous challenge in harnessing healthcare data.

While the industry faces unique data challenges, there are also a multitude of opportunities.

# UNTAPPED POTENTIAL OF DATA SCIENCE IN HEALTHCARE

Data science has immense potential to transform healthcare. It is expected to allow health systems to improve care and reduce costs by better tailoring and anticipating the right care for the right patient, at the right time.

However, despite the generation of so much data, overall the adoption of data and data analysis in healthcare compared to other industries is low. While industry research shows there is huge value that data analytics can help create, less than 20 percent of that has been captured. One reason is that the massive amount of data often resides in a fragmented application landscape—housed in silos in separate systems and managed by different departments and personnel. Other reasons include the privacy of health information, security, budget constraints, lack of process and organizational change, shortage of technical talent, data-sharing challenges, and regulations.



**Tapping the huge reservoir of healthcare data is expected to ultimately improve patient health and decrease medical costs. Industry reports and surveys indicate that data science and analytics can reduce US healthcare costs by \$300 billion<sup>6</sup>.**

# DATA SCIENCE: A BOOSTER SHOT FOR INNOVATION

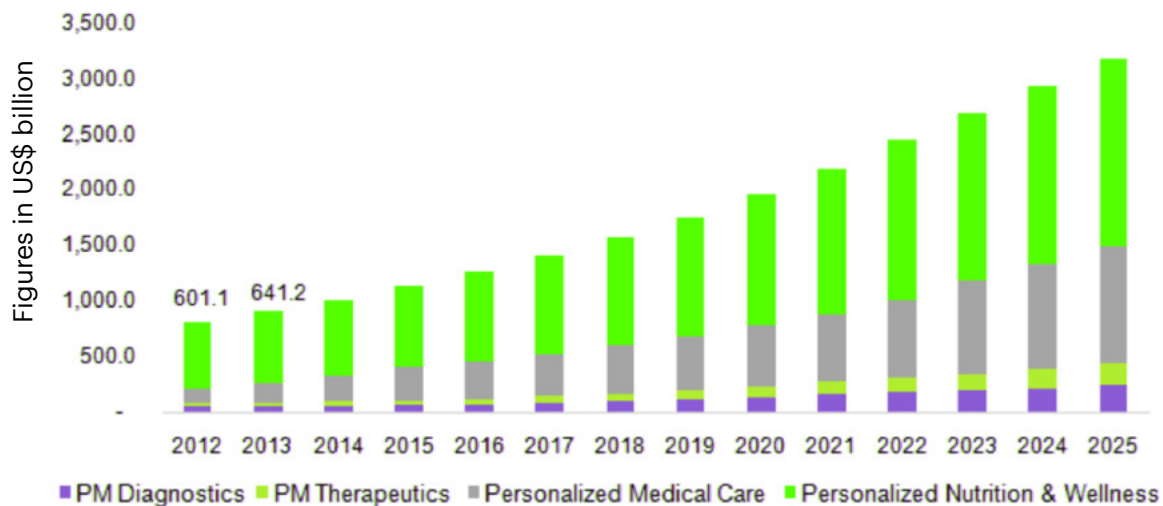
Data science can be gamechanger in healthcare. Let's explore some areas where data science can make a real difference.



## PERSONALIZING CARE

Personalized medicine is an approach for disease treatment and prevention that considers individual variability in genes, environment and lifestyle for each person. Data analytics has the potential to launch a new era of truly personalized medicine. This is especially true as a huge amount of new biological data is now available, thanks to developments such as genome sequencing costs coming down or the advance in the study of proteins. The focus is now turning to using data to predict patient behavior, thereby moving toward personalized and outcome-based medicines.

Figure 2. Global personalized medicine market by product



PM - Personalized Medicine

Source: <https://www.grandviewresearch.com/industry-analysis/personalized-medicine-market>



By harnessing health information—including data on treatment outcomes, genomics, lifestyles, chronic diseases, and more—from various populations and numerous sources, tailored care and treatment can be provided to individuals, and that would result in more effective outcomes. For example, instead of treating a patient with a drug that works 80 percent of the time, doctors can use data science to come up with a customized regimen that suits the patient's genetic constitution.

Further, analytics can be used to predict the potential occurrence of diseases such as cancer and create personalized development plans to increase the likelihood of detecting cancer. These studies could lead to the identification of the gene that can mutate and result in scenarios like cell malignancy. This would, in turn, open avenues for developing customized treatment plans. Considering the genetic makeup of an individual, medicines that would better suit the patient and have fewer side effects can be given.

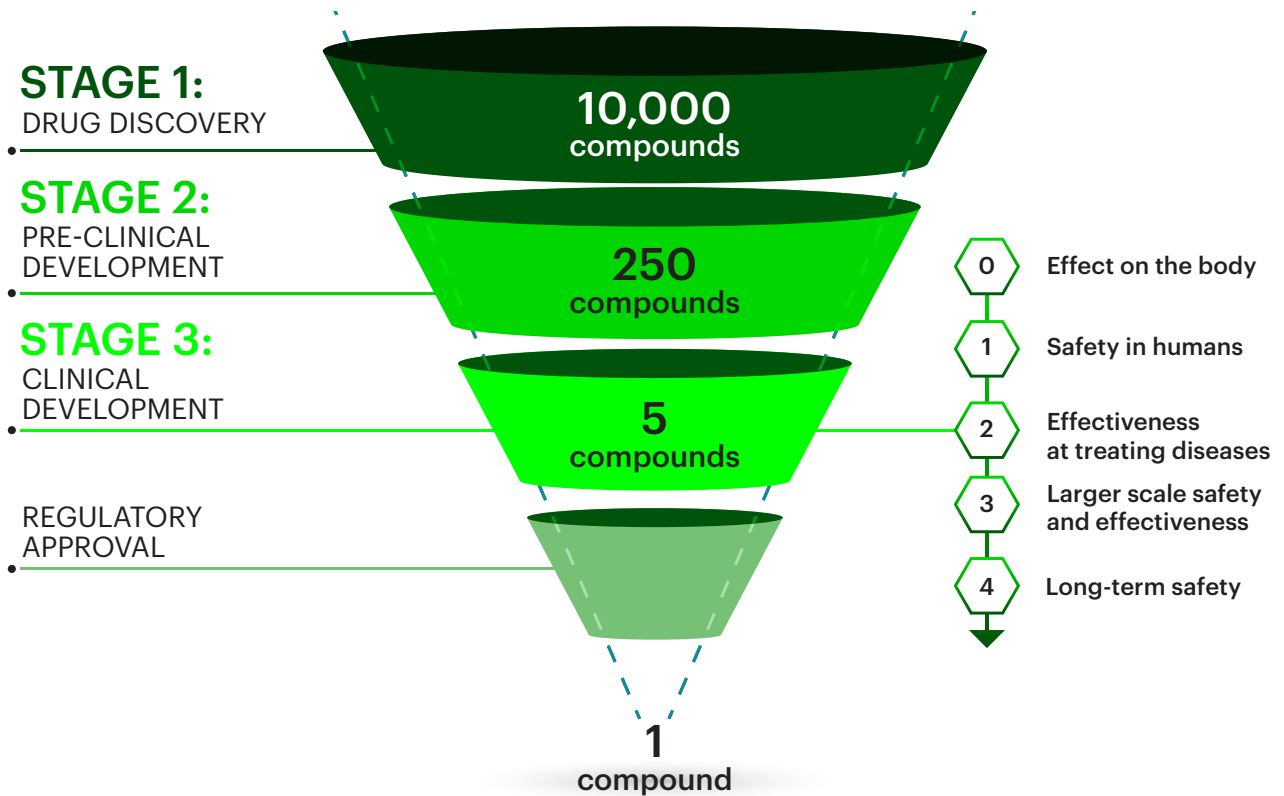


## FUELING DRUG DISCOVERY

Drug development is a lengthy, complex, and costly process, with a high degree of uncertainty in the exploratory research phase. As many as 90 percent of drug candidates fail to make it to the market. Today, it takes a pharmaceutical company more than 10 years and more than a billion dollars to get a new drug to the market<sup>6</sup>. Though the funding for drug discovery has doubled in the past decade, the number of new chemical entities submitted to the Food and Drug Administration for approval has been on the decline. Faced with these challenges, the industry is looking to adopt newer technologies to improve and accelerate the current process.

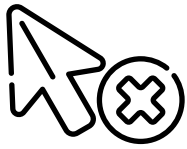
With the use of algorithms that can read through diverse genetic data, the possibilities of capturing newer insights that are clearer, consistent, and transparent have increased manifold. Additionally, advanced analytical support tools can flag potential failures or dangerous drug interactions for scientists and doctors alike, helping them make more informed decisions and minimizing the risks of human error.

Figure 3: The long, winding road to the market



**Analytics-powered drug research is expected to cut costs and time to market, help repurpose pre-approved drugs more easily for new applications, and empower computational chemists to make discoveries that could lead to cures for a range of diseases faster.**

**Amgen’s acquisition of deCode, a human genetics company, has transformed its drug discovery process. Today, Amgen validates all its target molecules against the genetic database for potential failures and prioritizes the ones with higher success rates.**



## REDUCING MEDICAL ERRORS

### **In the United States, a recent report found that preventable medical errors were the third leading cause of death.**

In medicine, drug interactions and incorrect dosages often have life or death consequences. A study has found that nearly 5 percent of hospitalized patients experience adverse effects from drugs—from incorrect drug choices or dosages<sup>8</sup>. One landmark study in 2000 estimated that anywhere from 44,000 to 98,000 Americans die each year as a result of preventable medical errors<sup>9</sup>. Later research building on that study and applying a quality-adjusted life-year analysis estimated that the associated costs could be as high as \$100 billion annually in the United States alone<sup>10</sup>. Now, advanced analytical support tools and automated decision making can recommend the right drug and the right dosage. They can also flag potential allergies or multi-drug reactions. The benefits of reducing medical errors are huge: saving the direct additional costs that would have gone in to correct the errors; no loss of productivity for patients; and most important, saving lives. Assuming that analytics could reduce medical errors by approximately half, the total impact in high-income countries could approach \$200–300 billion<sup>11</sup>.

The opportunities presented by data in healthcare are immense, but so are the obstacles the sector faces as it evolves. To move forward, the industry must address several challenges such as data sharing and security, data governance, EMR integration, and so on. Further, they must address the acute shortage of skilled resources, especially business analysis (BA) professionals.

# MEET THE INDUSTRY EXPERT

BA professionals play a critical role in pharma and healthcare as they help in deciding the key business priorities for the organization and bring about a user-centric approach in terms of which therapeutic areas to focus, what treatment plan would work better for a specific population, and so on.

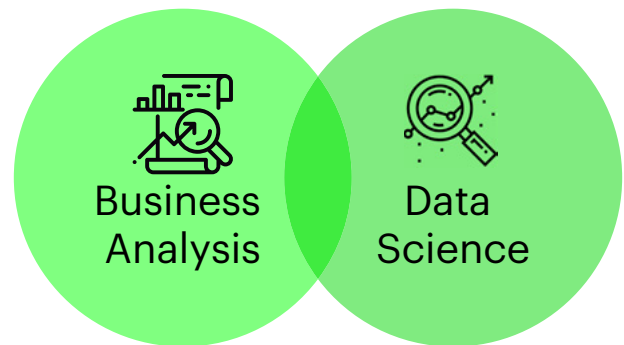
As healthcare industry experts, BA professionals would help outline the business needs of the organization. Once the business problem is identified, they can ensure that relevant data is identified, documented, processed and made available to the appropriate analytics users and applications. For example, different types of problems will use different resources and supporting data. A project focused on decreasing wait times for appointments, for example, will require different data sources and involve different staff than, say, a project focused on reducing waste in the pharmacy department.

Another area where BA professionals with good domain knowledge can be of great value is stakeholder analysis. Many stakeholders in a healthcare organization can be impacted by analytics projects. Each stakeholder has unique analytics and communication needs, and each stakeholder's input is critical to the success of a project. BA professionals are crucial in understanding these business needs and in coming up with actionable items to address them.

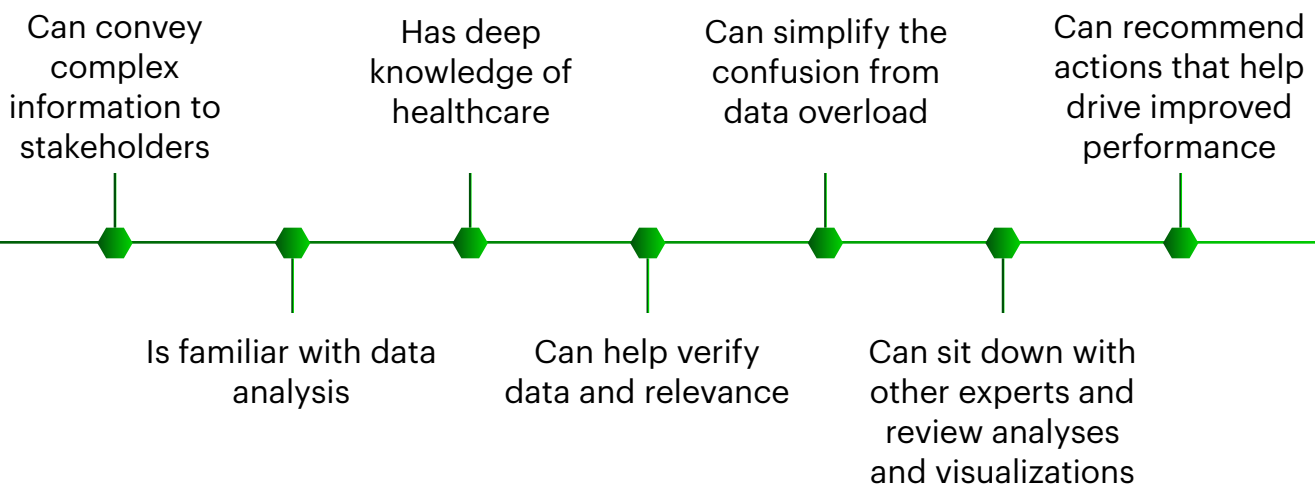
**Critical skills of a BA professional: domain expertise, critical thinking, ability to adapt to changing business needs, aptitude for innovation, and storytelling**

# BA & DATA SCIENCE: A PERFECT MATCH

Business analysis involves analyzing business processes or systems, and assessing the business model and its integration with technologies such as data science. However, many organizations focus mostly on the need for data scientists assuming it would suffice for analytics transformation and ignore the role of BA professionals who can, in fact, play a crucial role in this transformative journey. BA professionals can serve as a link between analytics talent and practical applications to business questions. Bringing BA professionals on board will have a bearing on whether an organization’s investment pays off and translates into actionable insights.

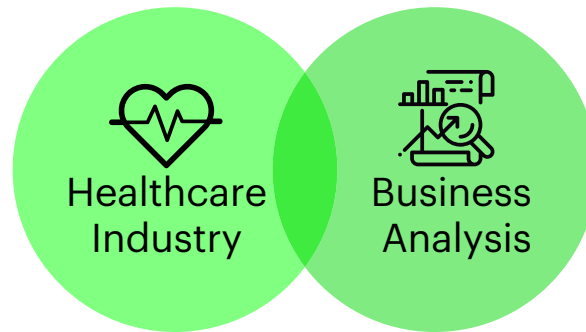


## WHAT ARE THE COMPETENCIES REQUIRED FROM A BA PROFESSIONAL TODAY?



# THE ROAD AHEAD FOR BA PROFESSIONALS

Historically, BAs in health systems have not played visible roles. They have spent their days sifting through existing applications for potential enhancements or going through the defect lists to analyze root causes. But BA professionals can no longer afford to cocoon themselves in these roles.



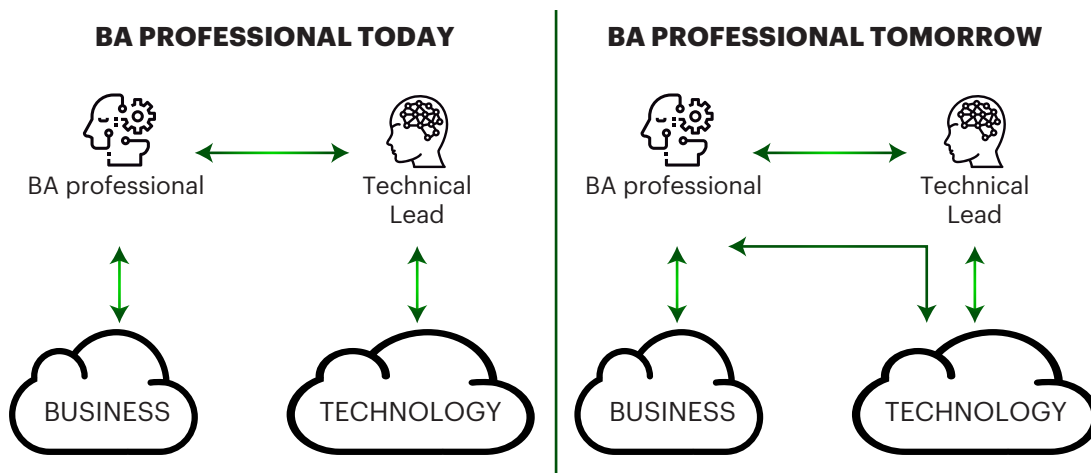
With business becoming increasingly data-driven, BA professionals today need to work with the business and teams in charge of data to ensure that the right data is available at the right time, in the right place and to the right people. The expectations from BA professionals in the data science age have changed dramatically. With the surge of big data, there will be a higher demand for BA professionals to support the business by:

- Defining the data needs of different business areas:**  
 BA professionals can collaborate with data scientists to decipher patterns in genomic and proteomic measurements, thereby opening new avenues for personalized medicine and early diagnosis of diseases such as Alzheimer’s and cancer.
- Providing the right data to help the business make informed decisions:**  
 BA professionals can play a pivotal role in helping the business identify the correct KPIs, for instance, to measure the progress of clinical trials. In the case of multi-site, clinical trials, it is imperative that the right performance parameters such as site performance, patient retention, safety reporting, and others are accurately reported.

- Ensuring that the reporting needs of the business are met:**  
 Since BA professionals understand the business challenges, they will be able to identify appropriate performance indicators to enable real-time reporting and hence, faster and smarter decisions.
- Ensuring that the attributes of data, the relationship between data elements and sources of data are defined and mapped:**  
 The R&D arm (especially drug discovery) of pharmaceutical drug development is constantly plagued by challenges of fragmented data and hence the inability to establish co-relation between relevant research entities and derive meaningful insights. Business Analyst with subject matter expertise should be able to identify data entities and their relationships, to improve downstream processes.
- Transforming data into meaningful information that the business can use in making decisions.**  
 BA professions can help derive relationships between various data entities and identify the best visualization tool or tools appropriate for the business.

BA professionals will increasingly play a pivotal role in the data analysis strategies of healthcare organizations. However, to make most of this opportunity, BA professionals must transform themselves. In a world where technology drives businesses, they cannot remain distant from technology. To start with, they need to refresh their knowledge of statistics. They should also familiarize themselves with the latest technology, such as machine learning; understand the possibilities offered by technology, evaluate its utility, applicability, and benefits in specific business situations; and elicit and communicate requirements in a creative manner to implement a solution for a business situation.

**BA professionals cannot remain technology agnostic**



# BUSINESS ANALYSIS AND DATA SCIENCE IN ACTION:

## REDUCING DIABETES MELLITUS READMISSION RATES

Let's look at an illustrative case study and see how data science can reduce diabetes mellitus readmission rates.

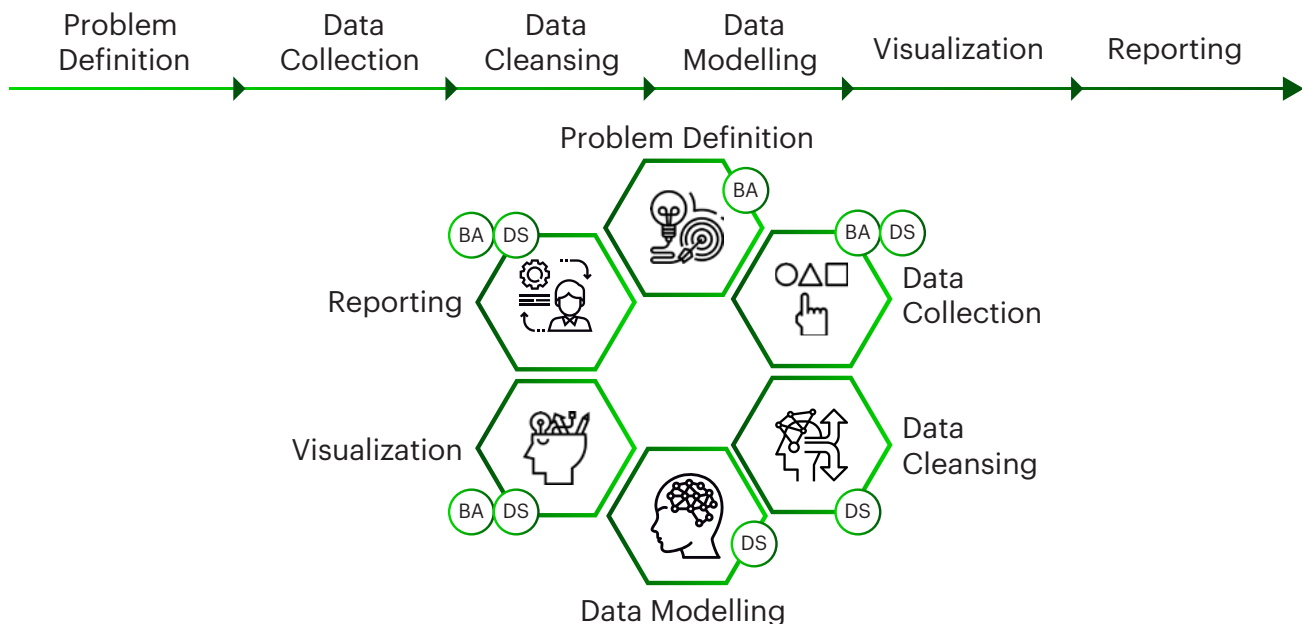
### Case description

Diabetes mellitus is a chronic lifestyle disease affecting 8.5 percent of the world's population<sup>12</sup>. The objective of this study is to show how BA professionals, data scientists, and others can come together to apply data analysis for early detection of diabetes mellitus readmission cases, based on factors such as ethnicity, age, body mass index, hereditary, and trend of glucose levels. This might give insights into preventive care and help avoid hospitalization, where possible, leading to a better quality of life for diabetic patients and cost savings.

### Case discussion

The process of data analysis comprises five steps: problem definition, data collection, data cleansing, data modelling, data visualization, and communicating results. BA professionals can follow the proven methodology of OSEMN to solve data problems.

Figure 4: Data science process flow





## Defining the problem

At the outset, the business problem or the question to be answered must be correctly identified. The BA professional needs to clarify what the stakeholders (endocrinologists, nurses, or quality managers) want to accomplish, or what problem they are trying to solve. He or she can seek answers for key questions (what data is required, is the data readily available, can the available data be used, and if the right data is not available, how to get the right data). Then, the BA professional can help the project team define the problem statement, which in this case is how to use the healthcare data to predict the outcomes of diabetes.

Once the team has identified the data needed and the sources of the data, it's time to move to the next step—data management. This covers collecting, cleansing, and modelling data.

## Obtaining data

The team acquires data from the source system. They may need to combine data from multiple and disparate sources and integrate them into one place of storage, often in a database. For this project, the team may collect current and historical data from multiple source systems, including the EHR system and quality reports, to determine current and historical re-admission rates.

Once the data dump is available, the data scientist can work with the BA professional to interpret the data better and correlate it with the original business goal.

## Scrubbing data

After acquiring the data from the source systems, the data scientist evaluates it to identify any data quality issues. The BA professional can validate issues identified and isolate the ones that are specific to the domain. The data scientist routinely performs data cleansing activities to amend or remove data that's inaccurate, incomplete, improperly formatted, or duplicated.

At the end of this stage, the raw data is cleansed to remove null and invalid values from the data set. Critical factors that do not influence the original goal is eliminated to obtain cleaner data for further analyses.

**Exploring and modelling data** The cleansed data set can be loaded for modelling. The data scientist and the BA professional then examine the data to determine relationships among the variables, looking for patterns, trends, and clusters. They may need to structure the data to accurately represent the relationship among the variables and put them in a format suitable for analysis.

The goal is to obtain constructive information that can be applied in answering questions, formulating conclusions, predicting outcomes, and supporting decision making.

### **Interpreting data**

The data scientist can use data visualization techniques to help understand and interpret the data. Several interesting characteristics come to light as a result. For instance, readmission rates are higher at one facility and can be linked to one nurse. This information could be helpful in identifying variations in practice that may be affecting patient outcomes.

Before the results are shared with the stakeholders, the BA professional, the data scientist, and the project team need to validate the results against the initial business objective by answering the following questions: Did we ask the right questions? Were the right questions answered? Did we perform the analysis correctly?

### **Reporting data**

The final step is the reporting of results to provide stakeholders valid information and useful insights. The primary goal is to communicate the key findings of the analysis. These key findings are the answers to the questions posed during the problem definition phase. Depending on the project scope, the BA professional may make recommendations to the end users or stakeholders.

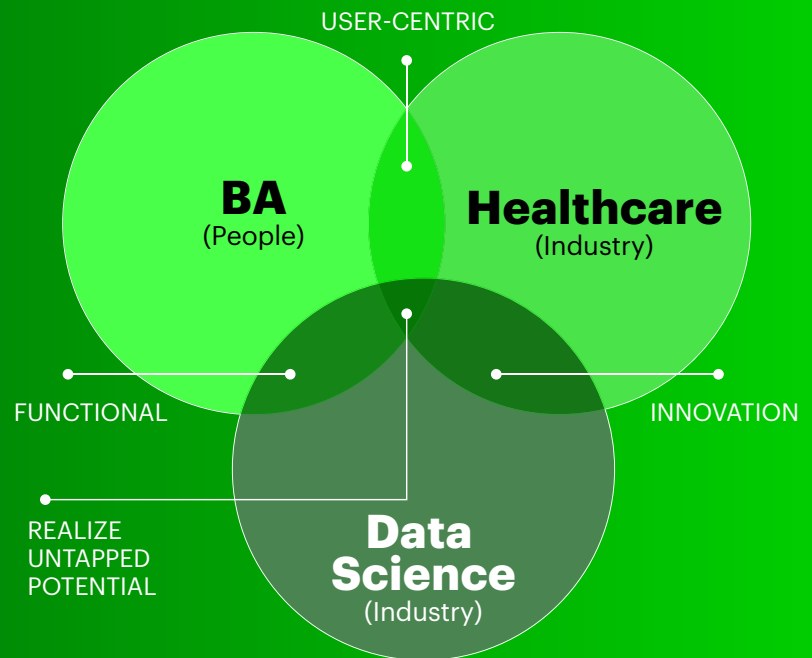
Final analysis reports need to be structured to facilitate understanding of the information for the intended audience. Understanding the information needs of the audience is important for the BA professional and the team as they prepare the final reports. For instance, an executive leadership report may be quite different from a report delivered to the quality management team.

The results of such predictions can be used to provide a heads-up to the patients so that they take the necessary precautions to prevent hospitalization.

# TRANSFORMING HEALTHCARE, TOUCHING LIVES

Data science and analytics hold huge promise for the industry. Healthcare is a data-rich domain. Unraveling the data-related complexities can provide many insights that could help make the right decisions for patients, at the right time. Efficiently utilizing the colossal healthcare data repositories can yield immediate returns in terms of patient outcomes and lowering care costs.

BA professionals have the “opportunity of a lifetime” to be able to touch the lives of patients and contribute to improving the quality of life. Business analysis professionals in the field of healthcare with an understanding of the opportunities available in data science can add immense value by providing functional expertise in identifying the appropriate business challenges that can be solved by analyzing data. They will be able to map the patterns and trends seen in data to a business problem, which could then translate to an actual product to disrupt the industry. BA professionals who embrace data science will play a crucial role in ensuring that the healthcare industry is able to tap the potential of data science.



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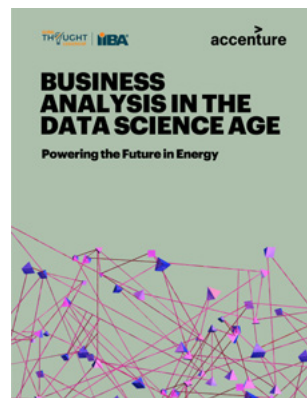
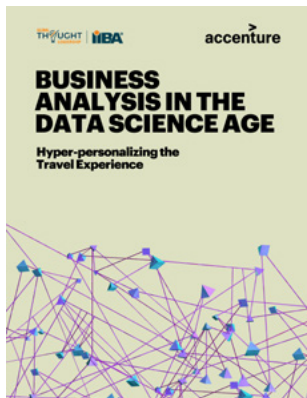
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# COMING UP



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