TECHNOLOGY
WATCH REPORT

Big Data in the social healthcare sector

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Big Data in the social healthcare sector

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1
Overview of innovation and tendencies in the social healthcare sector

Speaking of Big Data means referring to data bases that are so large and complex that it is difficult -or impossible- to manage them using traditional hardware and software. This big data may be **physical**, **virtual** or a combination of both, and is generally about one yottabyte (YB), equivalent to 1024 bytes. If we bear in mind that a scan of a single organ captures about **10 gigabytes** of raw data a second, then we can understand that the healthcare industry is creating and accumulating data at an explosive rate, 80% of which is non-structured. With an estimated volume of more than 300 exabytes in 2015, it is estimated that on a world level the volume of healthcare data increases by almost 50% a year.

But volume is not the only key characteristic of Big Data. The so-called Five Vs of big data also consider the complexity contributed by four additional factors: **velocity**, veracity, variety and value. With growing digitisation, data velocity is expected to increase exponentially, but the precision and quality of health data are a critical precursor related to its veracity and **value**, in a context with a tremendous **variety** of sources: electronic medical records (EMRs), medical devices, sensors, portable devices, mobile applications and research work.

"BDA technology provides aggregated data considered of value in the healthcare area because it helps to provide vision and aids decision making to advance towards a healthcare system that is more preventive, personalised and efficient"

Over the years, the healthcare industry has recorded **valuable sets of related data,** among others, with **medical records and tests** and **clinical cases** of procedures and therapies for the treatment of diseases. But it also generates large amounts related to various healthcare and social functions originating from medical **laboratories**, **pharmacies**, and healthcare **professionals**, as well as surveys of the **patients** themselves. **Big Data Analytics** (BDA) technology is currently used to:

- perform and interpret **diagnostic tests**, and **identify diseases** or syndromes
- better **understand** and predict diseases
- suggest the most suitable **treatment**, based on the records available
- predict the **probable result** of therapeutic treatments, foresee outbreaks and inform patients
- recommend **life styles** in function of psychosocial, economic and cultural factors
- **personalise** and systematise clinical care
- precisely measure and reduce the **adverse effects** of drugs
- develop **new drugs**
- optimise **clinical trials**, identifying new treatment protocols

- accelerate **genomics research**
- promote **research and development** in other areas and diseases

Experts point out that BDA is capable of transforming the way in which healthcare organisations offer clinical care, and that this may **improve the patients' quality of life and reduce healthcare costs**. In fact, crossing these healthcare records with demographic data contributes to improving the **management of healthcare services and quality**.

We can distinguish the following main functions of the application of big data solutions in social-healthcare systems:

Functions	BDA Solutions
Clinical excellence and support for clinical decisions	• Storage of clinical records and diagnostic tests • Compared efficiency • Clinical research • Clinical trials • Clinical decision support systems • Laboratory research • Bases and channels for supporting professionals
Excellence of processes in social healthcare service units	• Regulatory compliance • Supply chain • Purchases; cost and income management; finances • Insurance solutions • Claim management; quality • ICT infrastructures • Communication and sales • Predictive and prescriptive analytics at the social and health care point
Population management and public health policies	• Management of schedules, care times and professional workforces • Management of service units by patient groups and territories • Emergency systems; epidemiology and protocols • Management of chronic groups; co-ordination with social and educational services • Plans and health programmes for groups and territories • Health emergency risk plans and response systems • Data security and privacy; capture and exchange of healthcare data • Efficiency of healthcare units and channels; patient participation platforms • Evaluation of public health programmes • Adaptation to legislation and administrative procedures

BDA are gaining more and more acceptance in the fields of health and welfare, especially in the management of **patient data** and the shared storage of **electronic x-rays** that help to significantly reduce the repetition of tests and procedures.

The spectrum of potential improvements to the system originating from BDA solutions is quite vast, but there are **four outstanding key areas of innovation**: genomics, personalised medicine, telemedicine and collaborative research.

- In the field of **genomics**, BDA will enable automating the extraction of DNA and RNA molecules from tissue samples to analyse genetic variations. Genomic analysis enables determining efficient treatments and contributes to the diagnosis of cancer and evaluation of risk factors for specific diseases, among others.
- As the objective of healthcare is not only the universalisation of mass services, but also **personalised medicine**, special relevance is given to the concept of "Medicine P4": (personalized, precise, participatory, predictive) to suggest specific drugs and treatments, minimise therapy reviews and prepare for specific emergency protocols. The efficient accumulation, storage, management and analysis of data taking advantage of BDA tools are decisive for ensuring success in such aspects as: complete genome sequencing; mapping of diseases and conditions for genes and molecular pathways; epidemiological studies; prenatal treatments; epidemic and flu models.

"There are four outstanding key innovation drivers: genomics, personalised medicine, telemedicine and collaborative research"

- Advances in sensors and, as a result, the Internet of Things (IoT) enable measuring physiological functions, recording movement and even control the patient's medication by non-invasive means. One important consequence of this tendency is the reduction of patient hospitalisation times both initially and after surgery or examinations. This means that **telemedicine** not only reduces hospital-related medical bills, but also frees up resources, while at the same time providing precise information for studying patient welfare.
- The classic research laboratories in universities and academic institutes generate massive volumes of biological data, but their servers are not usually large enough, nor sufficiently dynamic, to manage the complex flow of technical data. On the other hand, even though the routines for structuring and storing data have improved over the last two decades, there is practically no laboratory or company that can independently produce the multidimensional data required to manage diseases, and they are not even able to use their historical log. These arguments strengthen the importance of open access to databases favouring **collaborative research** on an international level. In summary, current data on **genomics and others complex data sets are an asset**, and will become references in future research to the extent of the investment in their quality.

In fact, **technological advances** are key factors driving the growth of BDA in the social healthcare area. Improvements on horizontal data exchange **platforms**, analytics and sensors exponentially increase the significant application of healthcare big data, but in a context of increased pressure to **reduce healthcare costs** and convergence with technologies such as eCloud that further simplify these implementations. Cloud computers imply considerable

savings in infrastructure and maintenance for hospitals and clinics, enabling research workers and doctors to consult cases and collaborate on new projects. Given that the data is stored in the cloud increases the possibilities of hacking or modification and so its **security and privacy** become a key area of concern and, therefore, an additional target for investments. In spite of cost moderation, therefore, it is obvious that "Large data sets require specialised technologies, tools and technical services" for their efficient management in function of factors such as time, cost and professional competition.

According to the Frost & Sullivan report "Innovations in Big Data Analytics for Healthcare – A study where big data Applications in managing healthcare data effectively to improve patient outcomes" (2017), when we think about future social healthcare we should consider two lines of **technological convergence**, BDA as well as *cloud computing*: virtual reality and the *blockchain.*

"Large data sets require specialised technologies, tools and technical services"

Virtual reality will tend to be used to educate patients in healthy habits, such as giving up smoking, a healthy diet, regular exercise, overcoming depression, drug addiction or alcohol abuse, among others. By using this resource medical students can acquire a deep understanding of human anatomy through real-time interaction in a virtual environment, favouring controlled and safe learning experiences and opening a market for the on-line training of healthcare professionals.

The **blockchain**, on the other hand, contributes to designing intelligent contracts that permit consistent methods for accessing patient data in a standard way to pre-defined interest groups. For example, a single blockchain network could unite insurance companies, hospitals and patients without payments or with well integrated payments.

But the most significant impact of emerging technologies in healthcare services is expected to be the **change in business models**. Big data in itself will not bring about this transition; rather it will be the combination of technologies (mainly BDA and Cloud platforms) that will create new markets.

The report "Growth Opportunities for Healthcare Big Data - An analysis of global case studies" (Frost & Sullivan, 2016), estimates that the global market for Healthcare big data & analytics in 2015 was 4.4 thousand million dollars, and it is expected to reach **7.5 thousand million dollars in 2020**.

This large market is expected to redefine the **opportunities and tendencies** of various players in the value chain in the following way:

- **Public health sector**: Governments need data to improve the quality and efficiency of patient care, promoting the use of data to develop policies that lead to value-based healthcare models. In public services a progressive culture focussed on service and centred on the patient will aid in impelling big data. It is expected that the creation and application of structured health data to promote national health policies will increase significantly in line with new regulatory measures.
- **Suppliers:** Suppliers contribute to widening the use of big data in current applications, as well as to identifying new applications that could help us to offer data services to improve decision-making based on the evidence of clinical performance. Suppliers

will also use big data to develop their own business data and improve transparency to exercise technological surveillance and create new business opportunities. But these exercises in innovation of data sources and business models are closely tied to legislation as well as the ecosystems supporting suppliers.

- **Users:** Patients will begin taking an active role in the control and maintenance of their own health. The generation of data by patients and professionals alike is destined to be more important and structured, and tendencies indicate a patient with greater autonomy in data management and more demands related to its ownership. Even though the initiatives of open code and open data may have a strong positive impact on healthcare systems, awareness of the value of the active contribution of secure data by system users is still quite low.

As suppliers are already developing pilots with KPIs that guarantee the viability of projects, it is considered that consumers and governments will be the segments where innovation in this field will be concentrated. BDA plays an important role in helping health professionals to re-direct current practices, encourage continuous commitment with patients and help them manage their health experience.

But improving patient results requires **digitalisation and unification of health records**. In a setting with little standardisation of data, the **integration and interoperability** between sources and the co-ordination between various interest groups is a major challenge. In many countries the majority of healthcare data usually resides in centralised data banks that are little prepared for data exchange and which may even compromise data privacy. It is expected that this situation will bring about a tendency to growing collaborations between public systems and some private players to promote **research and development activities** in healthcare analysis, guaranteeing the financing of projects focussed, for example, on the development of interoperable **standards** and ad-hoc applications.

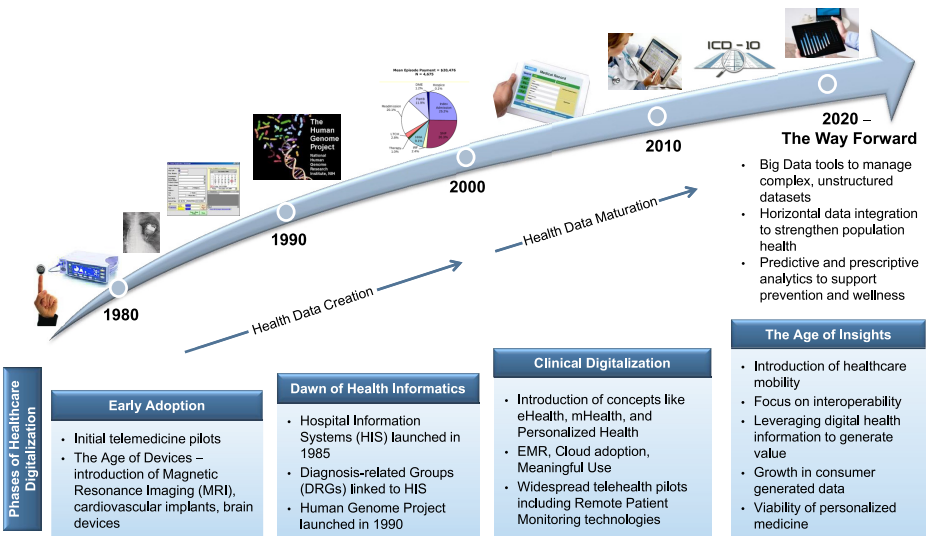
"It is estimated that the global market for Healthcare big data & analytics will reach 7.5 thousand million dollars by 2020"

Various international organisations develop initiatives and applications to help patients and professionals settle the technical bases to identify new opportunities, but the greatest obstacle to adopting big data is perhaps the human inertia created by a combination of fear and ignorance. There are considerable **social and economic challenges** to adopting big data in healthcare services and they are often related to designing regulations, short-term and short sighted organisational strategies, as well as with the difficulties of managing organisational changes to take advantage of the data generated by every day work flow. The organisational challenges are further complicated by **economic challenges**, because BDA infrastructures are costly and require considerable budget allocations for hardware, regular maintenance, update and configuration; a situation leading to sophisticated scenarios of amortisation and return on investment.

In this changing scenario, universities and corporations progressively offer qualification plans to attend to the growing demand for experience in BDA in the social healthcare sector. The **availability of technical knowledge** should become a less and less important barrier to striving to develop patient care applications, models and programmes.

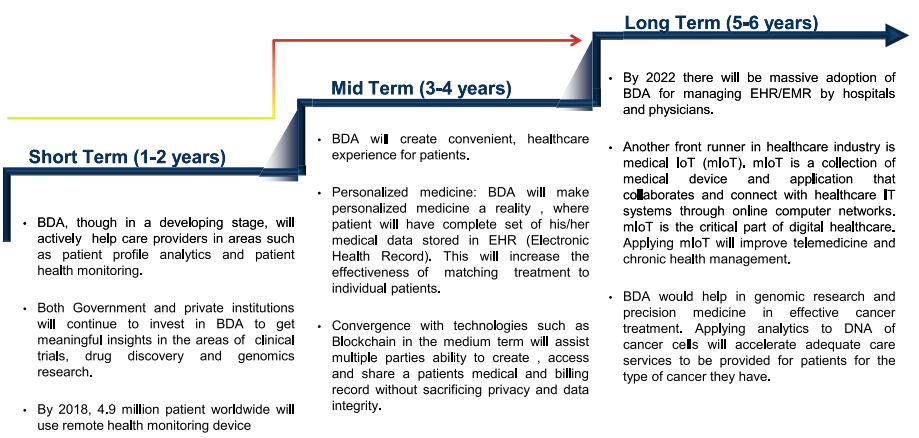
2
Big Data Analytics (BDA) for healthcare Markets and Innovations: Key Infographics

2.1. Total Healthcare Big Data Market: Evolution of Data in Healthcare, Global, 1980–2020



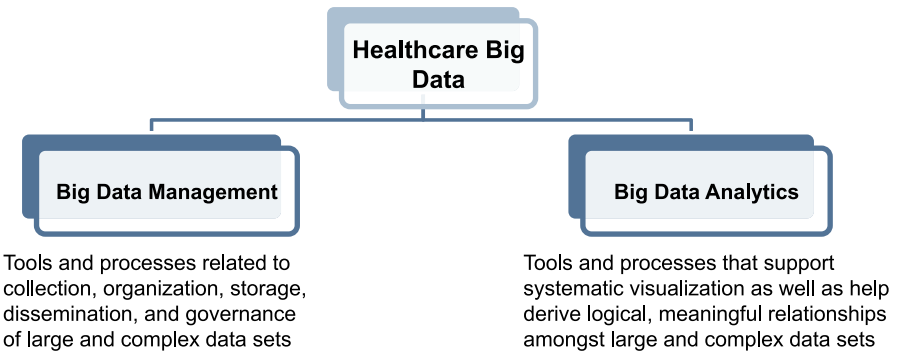
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.2. Healthcare Market: Technology Road Map and Future Opportunity, Global, 2017–2022



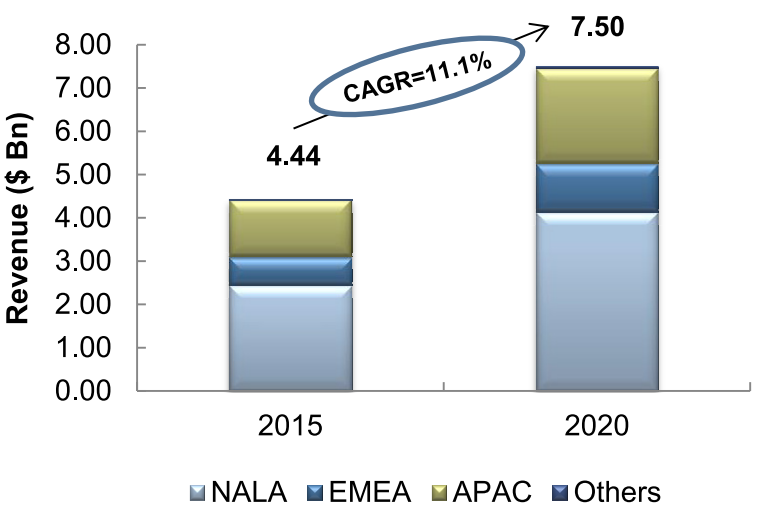
Source: Frost & Sullivan (2017). Innovations in Big Data Analytics for Healthcare

2.3. Total Healthcare Big Data Market: Market Segmentation, Global, 2016



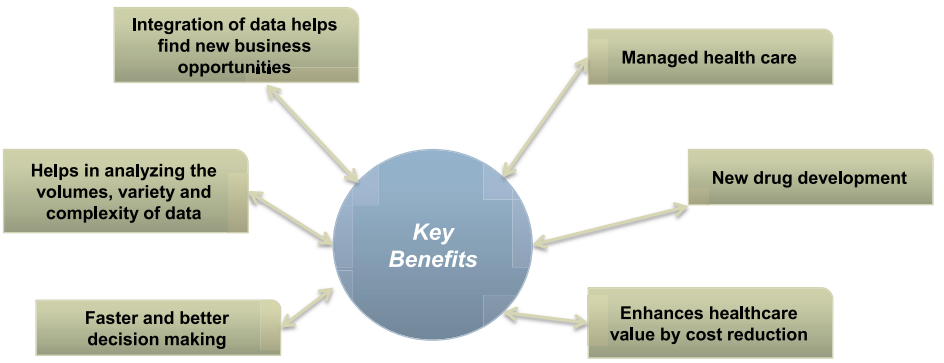
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.4. Total Healthcare Big Data Market: Healthcare Big Data & Analytics Revenue & Forecast, 2015 and 2020



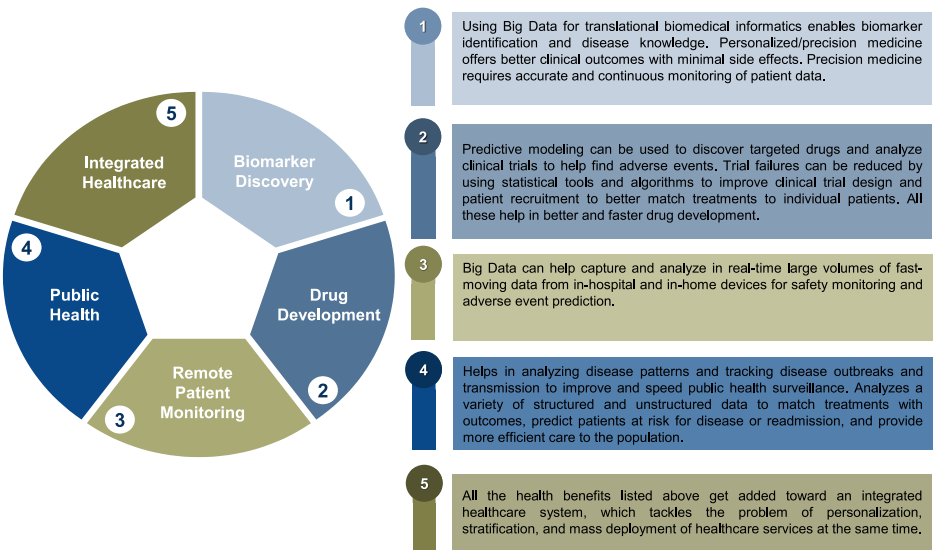
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.5. BDA Key Benefits



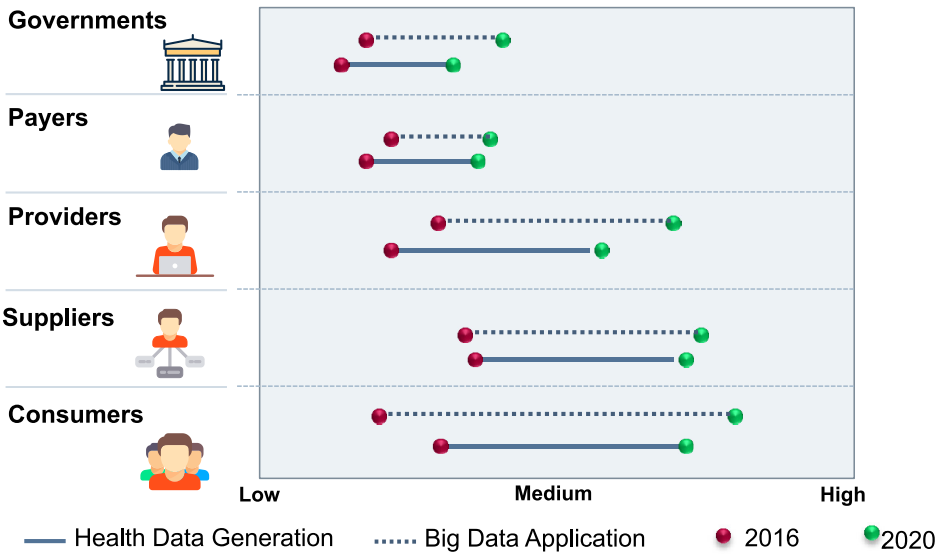
Source: Frost & Sullivan (2017). Innovations in Big Data Analytics for Healthcare

2.6. BD Applications



Source: Frost & Sullivan (2017). Innovations in Big Data Analytics for Healthcare

2.7. Healthcare Big Data Market: Big Data Market Progression, Global, 2016 and 2020



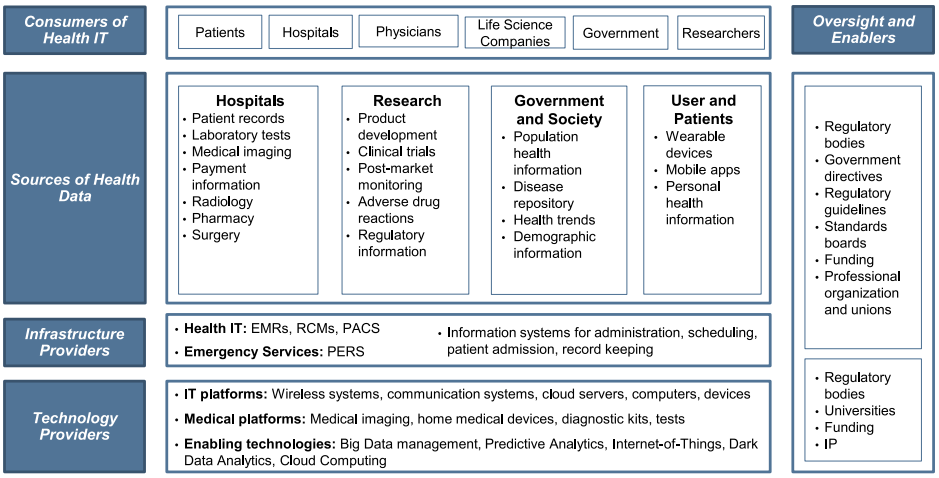
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.8. Healthcare Big Data Major Applications

Typical target customer	Governments	Payers	Providers Hospitals, Physicians, Pharmacies	Suppliers Pharma, Medical Devices	Consumers
R&D	• Public health policy research & development	• **Best outcomes, lowest cost care pathways**	• **Clinical research** • **Best outcomes, lowest cost care pathways**	• Laboratory research • **Clinical trials** • **Comparative effectiveness**	• **Real-world trials**
Operations	• Health data capture and exchange across various departments • Health economics	• Claims management • Population/ Employee risk management • Sales force effectiveness	• Hospital workflow • Regulatory compliance • Cost management	• Manufacturing • Finance • Supply chain management	• **Patient engagement platforms** • **CDS** • **Best outcomes, lowest cost care pathways**
Go-To-Market	• Public health data management • Public health programs • Emergency response systems	• Insurance solutions based on comprehensive patient data • Personalized health plans	• **Clinical Decision Support (CDS)** • Population Health Management (PHM) • **Chronic Disease Management (CDM)** • **Patient engagement platforms**	• Sales & marketing • **Real-world trials** • **Data-driven healthcare services**	• **Data-driven healthcare services** • **Home monitoring and CDM** • **Analytics for the consumer/patient**

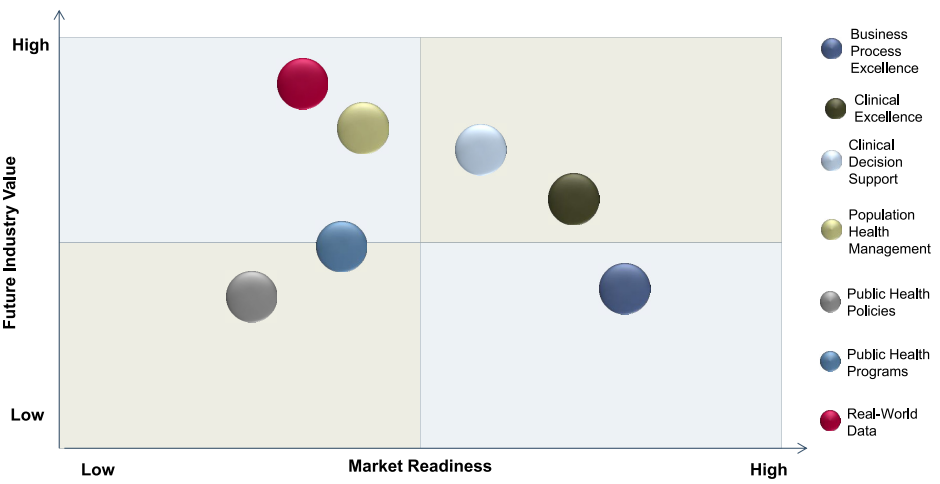
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.9. Information Technology in Healthcare Value Chain



Source: Frost & Sullivan (2017). Innovations in Big Data Analytics for Healthcare

2.10. Total Healthcare Big Data Market: Healthcare Big Data Opportunity Assessment Framework, Global, 2016



Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

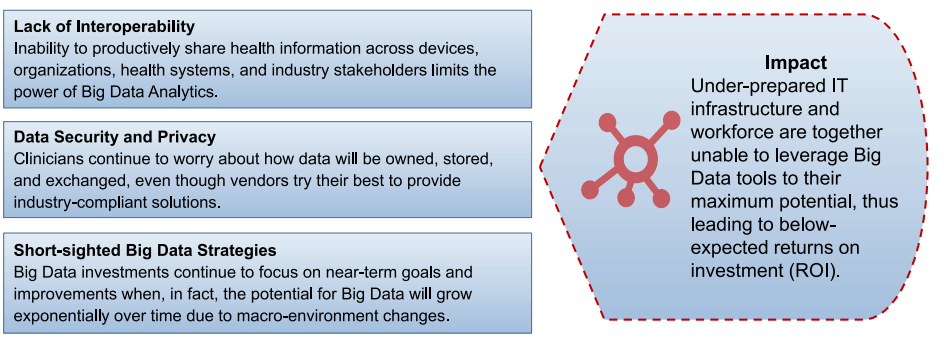
2.11. Major Trends Impacting Healthcare Big Data

Market Drivers & Restraints	Unmet Market Needs	Implications for Vendors
+ Over two decades of digitalization across various healthcare stakeholders has generated sizeable datasets.	• Meaningful analysis of the generated datasets that can help improve healthcare quality, efficiency, and experience.	• Immediate opportunity in interoperable Big Data Management solutions, but long term potential for analytics.
+ More than 200 start-ups since 2010 are focusing on creating advanced IT tools to manage and make sense of Big Data.	• Big Data solutions tend to be more reactive than proactive. Healthcare needs innovative ideas on using information.	• Opportunity for vendors to partner with visionary health organizations and co-design novel solutions.
+ There is an increasing awareness and penetration of devices and tools that capture patient-generated data.	• Meaningful analysis of unstructured data which accounts for over 80% of the data in healthcare.	• Untapped potential in the quality and volume of Healthcare Big Data that is currently being leveraged.
- Lack of Big Data knowledge and skills amongst healthcare organizations.	• Weak awareness on how Healthcare Big Data can be used and benefitted from.	• Opportunity for vendors to create new service line around customer training and education.
- Uneven infrastructure development globally including in telecommunications and health information exchange.	• Budget outlays in both public and private sector and across all stakeholders are a major challenge.	• Need to invest in public-private partnerships to drive a critical mass for adoption.

+ Driver - Restraint

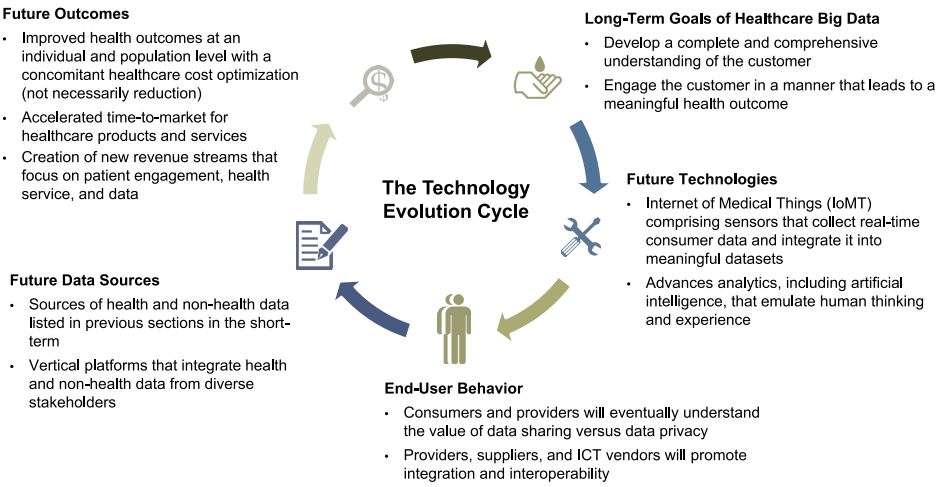
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.12. Major Challenges and Apprehensions Limiting Big Data Adoption



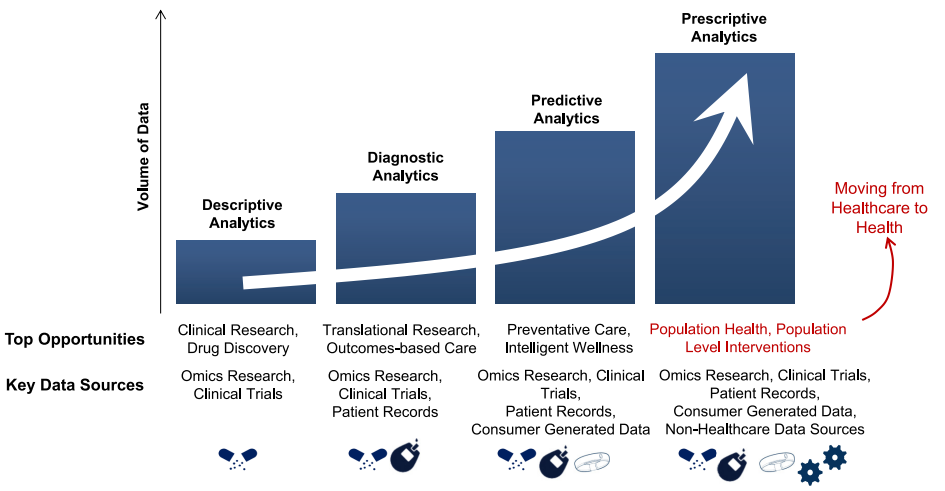
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.13. Total Healthcare Big Data Market: Big Data Evolution, Global, 2016–2020



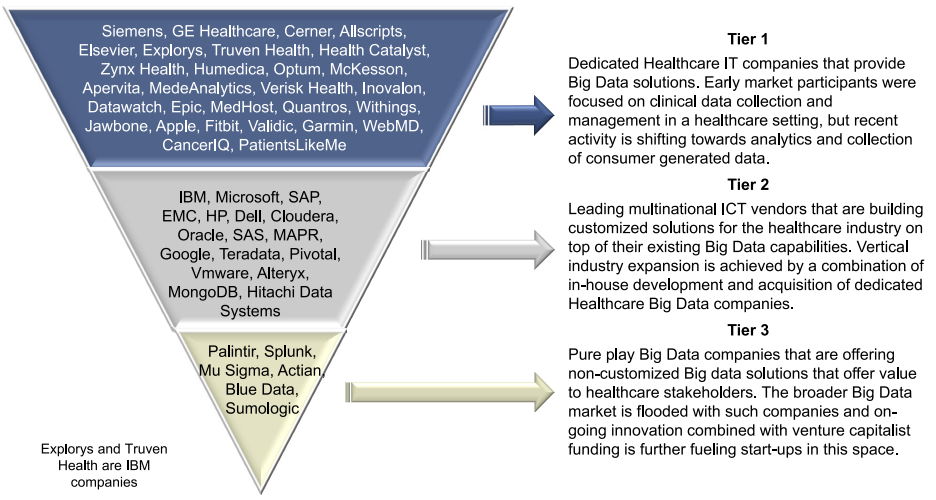
Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.14. Global Big Data Opportunity Roadmap by Type of Information



Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

2.15. Total Healthcare Big Data Market: Healthcare Big Data Vendor Landscape, Global, 2016



Source: Frost & Sullivan (2016). Growth Opportunities for Healthcare Big Data—An Analysis of Global Case Studies

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