Leveraging big data

to improve healthcare

Insights for healthcare executives

What we aim to answer
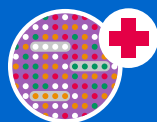
What does big data mean in healthcare and how is it changing the industry?

What are the technologies that can have the largest impact towards improving patient outcomes and delivery of care?

What are the challenges when it comes to evolving the healthcare landscape?

How can healthcare professionals use data and technology to their advantage and in turn improve patient outcomes?

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Big data

in the healthcare industry

Big data refers to the vast quantities of digitized information that gets consolidated and analyzed by specific technologies to reveal patterns, trends and associations that can be used to provide meaningful insights.[1]

While big data has long been harnessed by leaders across virtually every industry to improve processes and optimize solutions, it is of specific importance to the rapidly changing healthcare landscape.

The healthcare industry is faced with ever-growing pressure to deliver more, with fewer resources, and big data holds the key to improve efficiencies, minimize waste and ultimately deliver better patient care.

6 ways big data can help improve patient outcomes

DISEASE PREVENTION AND EARLY INTERVENTION

Insights gained from data can help healthcare professionals understand as much as they can about a patient and as early in their life as possible. Warning signs of serious illness can be flagged as they arise, and predispositions for a certain disease can also be identified (such as with genomic sequencing/screening data).

These insights could allow patients to make lifestyle changes or undergo interventions to treat disease early, or prevent it altogether. Early diagnosis is essential, as it has been shown to be linked with a greater potential for effective treatment, especially in the case of cancer.[2]

By 2025, it is estimated that up to two billion people around the world could have their genomes sequenced.[3] Genetic sequence data can reveal valuable health insights for patients – for instance, how they will respond to a given medication and dose.[4] This valuable information can in turn, be used to personalize care pathways for improved outcomes.

Prevention is better than treatment and managing to draw a comprehensive picture of groups of patients/populations with healthcare data analytics can help health systems identify focus areas where resources should be channeled.

For example, the recent ability to sequence the genomes of antibiotic resistant bacteria in preterm babies in a matter of hours has the potential to save many lives and bring about more effective treatments.[5]

IMPROVING STAFFING AND REDUCING HEALTHCARE ADMINISTRATIVE COSTS

By identifying patterns, big data can help reduce staffing costs across the healthcare industry. Using analysis to map admission rates throughout the year enables hospitals and surgeries to accurately allocate staff – resulting in less wasted resources.[6]

Furthermore, hospital managers who can better plan when additional staff is needed are potentially able to reduce waiting times and enhance overall patient care. Similarly, data sourced via wearable tech and health-tracking apps can reduce the tests a patient requires on arrival, creating a more efficient and less expensive treatment journey.[7]
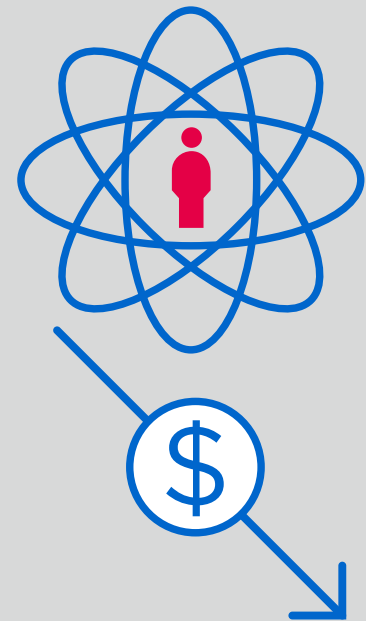
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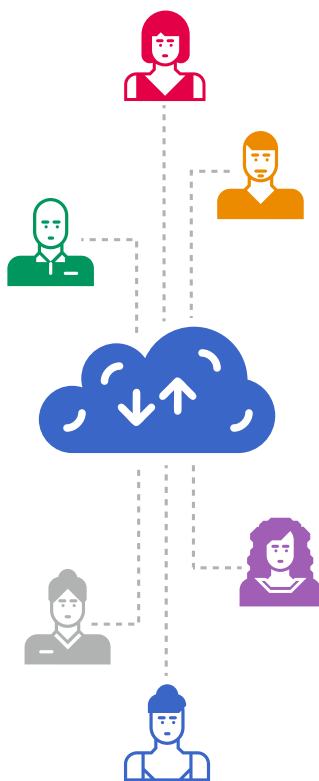
The digitization of patient records and the use of software tools allow staff to spend more time treating patients and less time recording.[3] For both patients and healthcare professionals, an ongoing challenge in the industry is the management of health records. By creating a central database for all stakeholders and using a single repository, caregivers could have access to the same data sourced by various institutions (for example hospitals, doctors, and community nurses).

For healthcare providers, this translates into a more efficient way of administering healthcare and can reduce time-wasting practices, such as repeat tests for patients. For patients, this could mean less visits to the doctor, reduced disruption to everyday life and less stress brought on by the need to manage their health profile.

FEEDING DATA FROM WEARABLE TECH

The rise of accessibility of wearable tech and tech apps has created a new era in health tracking. Today, a patient's heart rate, blood pressure, insulin, sleep and exercise – along with a number of other vitals in the pipeline – can continuously be monitored without interrupting routine. This allows for a more pro-active healthcare industry and real-time alerting, as well as the ability for healthcare professionals to build a more comprehensive picture of a patient's development.

ENHANCED PATIENT ENGAGEMENT

With the combination of the wellness movement seen in recent years, along with the rise in health monitoring devices, apps and increased accessibility to medical knowledge, more and more patients are becoming directly involved in managing their health and wellbeing. By allowing visibility of positive results of their behavior change in real time, patients are encouraged to be more pro-active, continue to monitor changes and be alerted to any health concerns as they develop.

As a result of the 'open results' culture, patients feel they have a part to play in improving their own outcomes and subsequently, are more conscious of their health and behaviors they can control to positively influence it.

IMPROVING DIAGNOSTICS AND DRUG DEVELOPMENT

Digital technology has the capacity to potentially give healthcare professionals the means to improve the efficiency and quality of their diagnostics by improving access to information. Such tools will aid in filtering and organizing the vast quantities of data already available from electronic health records. This will mean that a patient's health issues are detected more rapidly.

Accordingly, these tools may make it possible for healthcare providers to detect diagnostic errors more reliably and more quickly, potentially reducing the risk of these errors from occurring.[8]

Increased use of technologies, such as machine learning, may improve efficiency in research and development by allowing the virtual screening of millions of compounds, to potentially increase the number of possible drug leads.[9] Digital

solutions, such as clinical trial simulation, modeling and simulation, computer-assisted trial design, model-based drug development and model-informed drug discovery and development, could also begin to replace certain lab experiments.[10]

The result of this would be to reduce the time and resources required to bring a medicine to market.[6]

IMPROVING PUBLIC HEALTH MANAGEMENT

The use of big data has been shown to improve key areas of public health, including disease surveillance, risk prediction, targeting interventions, and disease understanding.[11] Disease surveillance is the most commonly cited area that has been revolutionized by big data. One example is the recent Ebola epidemic, which was tracked using electronic health records and location data from mobile phones, to detect highly affected areas and help fight the spread of the epidemic, as well as provide care and rehabilitation services to these identified regions.[6]

On a more localized level, one can see how researchers benefit from biobanks that are linked up with patient treatment records. Only with a comprehensive picture can medics illuminate patterns, mutations and trends that will lead to better patient outcomes.

Key challenges of big data in the healthcare industry
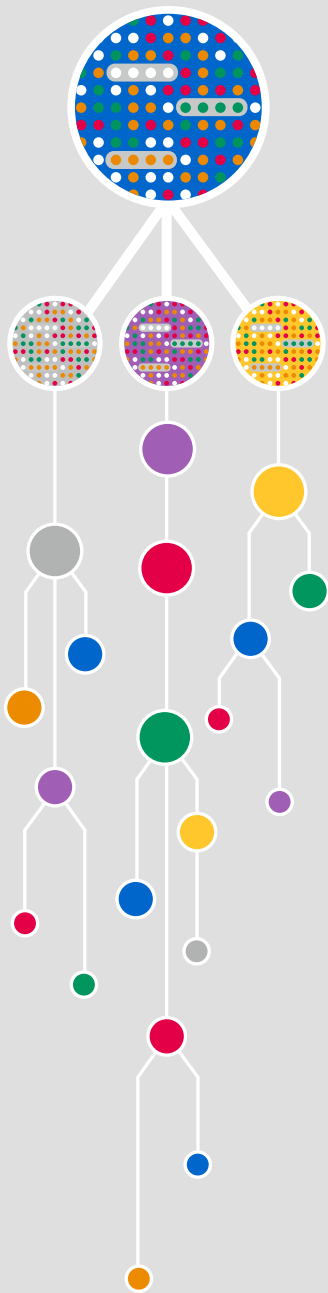
INTEGRATION

In some cases, the vast amount of healthcare data means it can be dispersed and more difficult to transfer between different hubs. The integration of huge data sets can be a very involved task – with numerous stakeholders to manage and multiple levels of regulation.

There are several challenges integration can result in, such as, data curation, capture, sharing, search, visualization, information privacy and storage. To ensure the efficiency of big data across the industry, it is crucial that datasets are structured and can be integrated. This will allow for the creation of a single repository – enabling fast and accurate diagnoses for patients and improved treatment and care pathways.

PRIVACY

The privacy of patient data encompasses numerous subsections of big data, including access to personal information, data potentially being handed to third parties, and adverts being targeted at patients according to their medical histories. Patient data is frequently managed via online systems that nurses and doctors widely use to deliver patient care.

Wearable tech poses another potential threat to a patient's privacy as more partnerships between global tech providers and healthcare companies emerge. In order to maintain credibility, the healthcare industry must promise to put users in control of their data and stay transparent about the range of data collected.

Big data in the healthcare industry

CULTURAL CHANGE IN HUMAN BEHAVIOR

Embedding big data and new technologies within a company is important to help drive businesses forward. However, this requires a great shift in human behavior and culture, which can be challenging. To address this may require big internal changes such as organizational alignment, new business processes, change management strategy and plans for communication, coordination and alignment.

Finding champions, supportive departments and teams is often cited as the key to creating a successful culture change. For example, finding advocates for sharing big data within the telecommunications company, Verizon, was crucial for shifting their company culture.[12] Other departments within the organization began to see how data and analytics were used by these advocates, which created momentum for others to adopt big data. The wider company is likely to embrace the change if they can see the benefits.

SUPPLY CHAIN

The challenge of supply chain is one that faces all industries, and with so many siloed applications and specialties, it's particularly important in the healthcare industry. Protecting the flow of patient information across different health sectors is vital. It is recommended that the standard of the primary company holding the data needs to apply to all the partner companies which subsequently attain the data. If facilitated, this protects the patients' privacy, while ensuring the efficient flow of their data can be passed freely to the necessary host.

How you can use big data solutions in your healthcare organization today

Meaningful insights generated from big data that are acted upon can save costs by improving efficiency across the continuum of care. Diagnosing and treating disease early with the right treatment will ultimately improve patient outcomes as we shift to a healthcare system that focuses on preventive healthcare rather than "sickcare". To truly realize the potential of big data in healthcare we need to bring together up-to-date data management practices. End-users of big data solutions and key specialists must collaborate at each stage of development to maximize the usability and quality of health data. A new policy framework that recognizes the need for data sharing is imperative.

ACTIONS YOUR ORGANIZATION CAN TAKE TO IMPLEMENT BIG DATA SOLUTIONS

- **Evaluate data management practices** in your organization to establish areas for improvement, and identify the correct stakeholders for streamlining across sectors. Furthermore, better data processes will minimize cost and reduce error across systems

- **Establish a skilled workforce.** Effective data management requires specialist training in data science and information technology, and detailed knowledge of the nuances associated with data types, applications, and domains, including how they relate to machine learning. Leaders should look into how data management specialists and knowledge engineers who can pool and curate datasets can be brought into their organization, as well as provide training to current employees to upskill their workforce

- **Be open to new collaborations and partnerships** to help realize big data potential in your organization. Encouraging on the ground collaboration with all stakeholders such as data scientists, field experts and end-users will achieve maximum usability of new tools or initiatives requiring the use of big data

Wearable health technology

– closing gaps in patient data and care

Wearable health devices are increasingly helping people to better monitor their health status – both at an activity level and for self-tracking of vitals, such as heart rate and blood pressure. These devices have huge potential in the world of healthcare. For example, digitally tracking blood sugar levels could help transform diabetes care for millions of patients, or monitoring heart rates for those suffering from heart conditions such as atrial fibrillation could help save lives.

Wearable tech has also opened the door to convenient remote monitoring. With the rise of chronic conditions, growing elderly populations, and increasingly hectic lifestyles that can contribute to a decline in health, we are already seeing a strain on health systems. According to a study by the World Economic Forum (WEF), the global economic impact of the five leading chronic diseases – cancer, diabetes, mental illness, heart disease, and respiratory disease – could reach $47 trillion over the next 15 years.[13] Throw in time constraints, consolidated healthcare resources resulting in longer distances that patients need to travel, and overall talent shortages, and one can see how affordable remote patient monitoring systems can help alleviate the burden for both patients and healthcare professionals.

Wearable tech has also opened the door to convenient remote monitoring

At a medical level, these devices are providing more data to clinicians with potential for earlier diagnosis and improved treatment guidance. Importantly, data from wearable health devices can provide clinicians with more accurate data compared to verbally reported information in face-to-face consultations with clinicians.

This is particularly helpful in the management of chronic conditions where patients need to report data over a period of time, or in older patient populations who may not recall all the vital information needed.

With the ever-growing importance of real-world evidence, wearable devices are becoming the source of lifesaving potential. The data collected from wearable technologies over a long period of time may be more representative of a patient's health status than measurements taken at a specific point in time, such as in a consultation or regular check-up.

The limitations of wearable tech
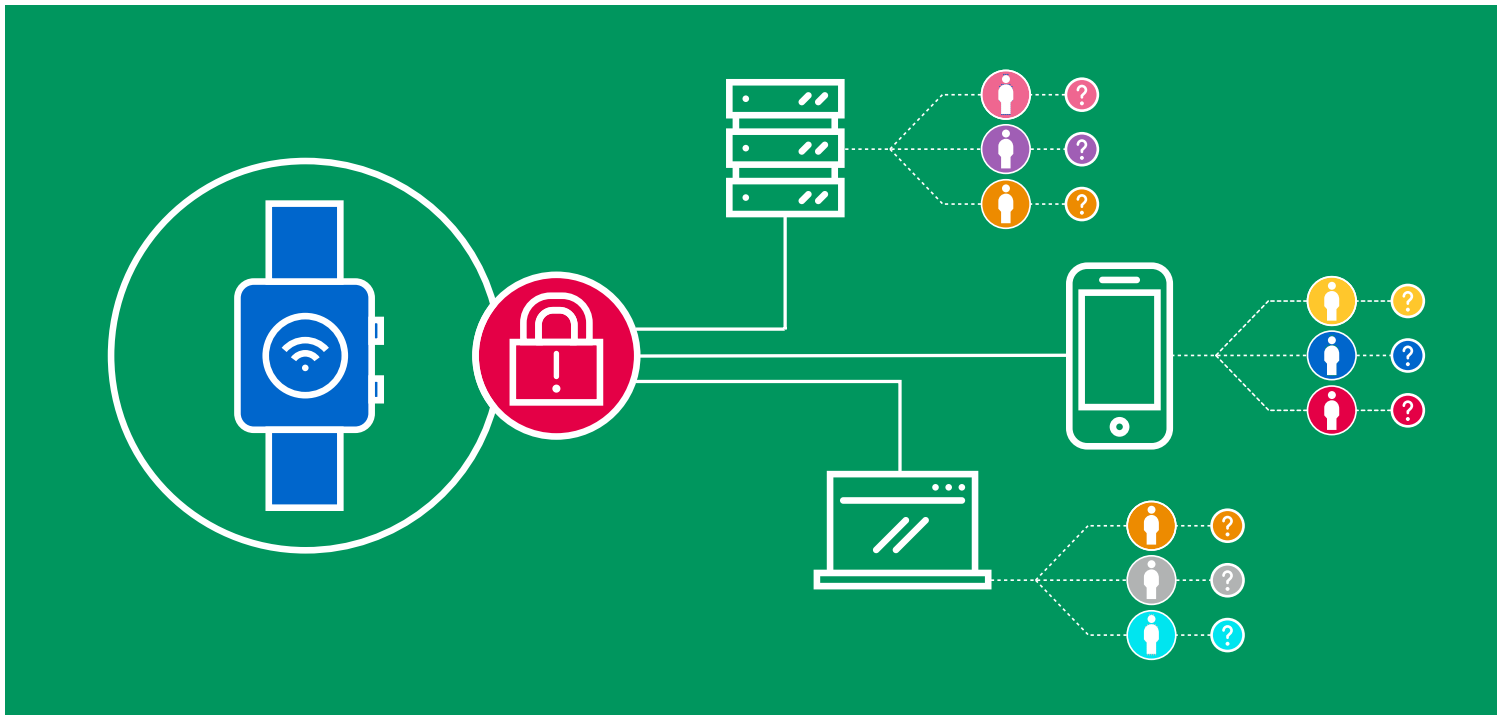
As with any digital revolution, the use of wearable tech comes with risks

Many of the potential problems predicted by analysts are the merging of private companies with a non-commercial health service. For example, major tech firms such as Google have partnered with independent hospitals – raising concerns about the containment of healthcare data.[14]

Secondly, the rise of tech must not eclipse the patient as the priority, or mean a compromise in healthcare regulation. To ensure patient safety and privacy in the future, regulations must be applied to all partnerships and protect both the tech and healthcare stakeholders. Above all, they must share the ultimate goal of making the lives of patients better.

ACTIONS YOUR ORGANIZATION CAN TAKE TO BENEFIT FROM WEARABLE TECH

- Consider how your organization could **encourage the use of data** in order to gather actionable insights from wearable health devices and integrate this into patient records to better support management of patients' health

- **Establish new methods of data collection,** to expand the capabilities of the team and source real-time data that can be used to build personalized patient profiles

- Provide macro level **staff training on the latest regulations** surrounding data sourcing

- **Equip the team at all levels with context and knowledge** of how to create data partnerships that will result in a wider offering for patients

Artificial Intelligence
– how healthcare is embracing it

Artificial intelligence (AI) has the capability of detecting meaningful relationships in a data set and has been used in clinical situations to assess patient risk, diagnose, provide treatment recommendations, and predict treatment results. Given the complexity and rise of data in healthcare, the sector is increasingly seeing the value in the application of AI.

AI has the potential to transform many aspects of patient care and can help clinicians, researchers, and administrators be more effective and efficient at their work. For instance, AI algorithms can be used to filter, organize and search for patterns in big data sets and using predictive analytics, can help healthcare providers make fast and informed decisions.[15]

An area were AI currently holds immense promise is in the analysis of medical imaging. AI-based analysis tools can help doctors identify conditions that might otherwise be missed by the human eye, such as breast cancer, brain injury, or heart disease. These technologies could lead to earlier and more accurate diagnosis, and ultimately better treatment care pathways and outcomes for patients.

AI allows healthcare professionals to personalize care for each patient. AI tools can be used to create individualized treatment plans that can reduce risks, improve outcomes, and cut staffing costs. The digitization of administrative tasks also reduces the risk of human error, a factor that can negatively impact healthcare spending and subsequently take a toll on the broader economy with indirect costs.

Challenges of AI in the healthcare industry

As AI continues to be adopted in healthcare, there are several hurdles and challenges. For example, privacy is enforced vigorously when it comes to medical data. As patient data is highly confidential, many hospitals and research institutions are wary of cloud platforms that use AI and prefer to use their own servers.[16] Stakeholders are continually working to improve the security of data and help doctors to feel more confident with the use of AI when it comes to patient data.

> *Another challenge AI faces is around the risks and doctor acceptance of the technology. Using AI to support in critical illness diagnosis is still a new way of working, which needs to be implemented slowly to instill confidence in the technology moving forwards*

A third obstacle for AI in healthcare is regulation. In other industries, it may be easier to access the information needed to train an algorithm. In healthcare, this information is highly regulated which makes it harder to get the volume of data necessary to develop safe and effective AI devices.

Data security and compliance with regulations is also essential in healthcare, meaning that AI devices must be compliant with the relevant agencies like the U.S. Food and Drug Administration and the European Medicines Agency.

Additionally, the transfer of human bias is a problematic challenge when it comes to AI. Human biases can make their way into AI systems with harmful results – a risk that needs to be taken into account when developing AI-based solutions.

Emerging AI in the healthcare industry

Now more than ever, healthcare organizations are looking to smart tech solutions to unlock new potential in AI

There are several examples of companies adopting AI in the healthcare industry. A pilot project is being run by Bering Research and general practitioners (GPs) at Axbridge Surgery in Somerset, UK to analyze the complexity of patients' health. The project aims to predict which patients might be at risk of needing to be admitted to hospital, and to help GPs to work to get that risk reduced. The AI tool presents its analysis in the form of a complexity score that is based on a percentage scale. The score is related to underlying health conditions and a range of contributory factors, such as high blood pressure or a history of smoking. A patient with a complexity score over 80%, for example, would be at high risk of needing to be admitted to hospital.[17]

Some unconventional examples include the computer software company, PathAI, which is developing machine-learning technology to assist pathologists in making more accurate diagnoses for patients. The company's current goals include reducing error in cancer diagnosis and developing methods for individualized medical treatment. PathAI has worked with drug developers like Bristol-Myers Squibb and organizations like the Bill & Melinda Gates Foundation to expand its AI technology into other healthcare industries.[18] US startup Hindsait helps insurance companies and healthcare organizations reduce costs while boosting patient health by replacing manual reporting, preauthorization, and audits with AI-based automation.[19]

California-based company Viewics recently became an integral part of Roche. This collaboration aims to help support customers around the world in improving their lab performance and processes by offering a digital platform to help unlock the value of their data. The insights generated can inform real-time decisions about costs, laboratory performance, and many other areas and can help to uncover potential value and profitability drivers in lab operations, as well as indicators to improve overall quality of care.

The future of AI for healthcare professionals

As innovation pushes the boundaries of healthcare, better solutions to save time, money, and efficiency will be possible by investing in AI. Advanced AI-based power assistants such as Cortana, Google Assistant and Siri are becoming a part of everyday life. When these algorithms are combined with healthcare apps, they will provide massive value to the users.

Healthcare apps will start to act as a personal health assistant. They will be used to provide medication alerts or signal when abnormal measurements arise so that a patient can check in with their doctor. Essentially, AI will be able to assist the patients when their doctors are not available.

AI systems will also increasingly help with diagnostic processes. They can examine medical images such as X-rays and can provide feedback on patterns that may otherwise be missed by the human eye. This will allow medical imaging analysis to become more accurate and effective and reduces the chances of errors in diagnosis.

ACTIONS YOUR ORGANIZATION CAN TAKE TO BENEFIT FROM AI

- **Identify potential growth areas within your organization that could benefit from the application of AI**, including return on investment evidence and practical applications for the treatment of patients. Starting small and witnessing success quickly is important to positively integrate AI-based technologies. It will be possible to scale up from there

- **Provide training on a case study basis that demonstrates how the use of AI has been employed** by other sectors in the healthcare industry and how it has changed the landscape of patient care so far

- **Evaluate and identity possible long-term partnerships to co-develop and implement custom AI-based solutions** that best suit the needs of your business. The solutions will evolve along with the company and off-the-shelf systems are not optimal as every business and the workflows or inefficiencies that it sets out to solve are unique

Closing summary

As one of the largest and most complex sectors in modern day society, there is a constant demand for a better and more efficient service within healthcare for patients. Healthcare professionals are handling and collecting more and more data each day – so it is no surprise we are constantly seeking more effective solutions when it comes to the digital handling of information.

The potential impact data innovations could have is monumental in terms of improving the lives and experiences of patients.

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