Big Data's Role in Patient-centric Care

Effective use of big data could reduce healthcare expenditure by 8%, making $300 billion in savings every year, according to a study from the McKinsey Global Institute.[1]

There's no doubt that healthcare's digital transformation makes sound business sense, cutting down on administrative and clinical inefficiency. According to analysis from Accenture, digitisation will fuel almost one-third of growth and 40 per cent of profitability in the pharmaceutical market by 2020.[2]

However, as the NHS moves ever further into the digital sphere with a commitment to paper-free, cloud-based systems and a greater investment in AI and data analysis, it's important to ask how the rise of big data will affect patients themselves.

Thanks to constant technological innovation, patients have more involvement than ever in the care they receive. Technologies such as mobile healthcare apps and wearables have granted patients greater access to information about their own illnesses and care, changing their expectations about diagnosis, treatment and disease management. This same technology also offers a cost-effective and less intrusive method of monitoring health, with patients' questions about their conditions answered in real time.

To meet these expectations, the healthcare industry needs a fully connected IT infrastructure, integrating information from multiple systems to ease administrative workloads, facilitate patient-provider collaboration, and improve quality of care. In this sense, big data can be seen as part of a wider movement toward patient-centric connectivity, enhancing the overall patient experience both directly and indirectly.

Healthcare staff need to corroborate data meaningfully via cutting-edge analytics technologies, pre-emptively spotting new opportunities for adding value to the patient experience and demonstrating transparency and trust via 24/7 personalised care. This calls for an in-depth analysis of how big data is currently affecting the industry, and how we can build on this to place a patient-centric data system at the core of big pharma business strategy.

What is Big Data?

The term 'big data' refers to large and complex data sets that require specialist processing software to store and analyse.

Over the last few years, we've become accustomed to generating data in almost everything we do, from shopping to travelling to interacting online. In fact, 90% of the world's data has been created over the past two years, showing the exponential rate at which our records are growing.[3] As advances in technology allow us to collect and analyse data more efficiently, this information can be used by businesses and healthcare professionals to understand the needs of their audience and improve their service offering. Big data also uses inductive statistics, inferring laws and relationships between sets of data and allowing analysts to predict outcomes and behaviours, pre-emptively responding to consumers' needs.

The healthcare sector currently deals with an estimated 50 petabytes of data, predicted to grow to 25,000 petabytes by 2020.[4] With organisations increasingly turning to online data storage, this information can be analysed on a global scale, helping practitioners to prevent epidemics, avoid preventable deaths, and improve quality of life for patients.

Big data allows us to view patients as consumers and analyse the decisions they make when it comes to their treatment. With healthcare data being generated about individuals from the moment of their birth, analysts are now keen to understand as much about patients as possible, picking up on potential illnesses at an earlier and more easily treatable stage, and personalising care at every step of the way.

How Has Big Data Transformed the Clinical Process?

Big data already plays a significant part in drug discovery, with researchers relying on AI systems to select the most promising drug candidates from a library of millions of molecules. Leo Barella, Global Head of Enterprise Architecture for AstraZeneca, went as far as to suggest that data-driven AI will be the primary tool for drug discovery by 2027.[5]

Once an appropriate drug is discovered, big data is consulted once again in the design process, with patients' trending preferences in the shape, size and amount of pills taken into account. This ensures that patients' expectations are being met, down to even the most aesthetic details of their treatment.

Clinical trials also benefit from the prevalence of big data. The increasing amount of available information on applicants allows researchers to pick the most appropriate subjects for their studies, and monitor them more closely throughout the trial process. With 85% of clinical trials failing to retain enough patients, personalising processes is a pressing concern, with the potential to save millions by getting drugs on the market sooner.

Big data lends itself to collaboration as well, with key pharmaceutical players sharing data between organisations in order to speed up research and development processes and make new breakthroughs. In fact, in 2013 publically available data from FDA-approved drugs led Stanford researchers to discover that the antidepressant desipramine had potential to cure small-cell lung cancer, for which there had previously been few reliable treatment options.[6]

Researcher Atil Butte commented on the relative time and cost efficiency with which the discovery was made, saying "We are cutting down the decade or more and the $1 billion it can typically take to translate a laboratory finding into a successful drug treatment to about one to two years and spending about $100,000."[7]

All of these factors indirectly improve patient experience, making more effective treatments more accessible than ever before. Big data can go one step further, however, directly changing the way we approach patient care.

Personalised Care

While big data allows us to analyse trends on a massive scale, it also offers us unique insights into individuals. By tapping into the data generated by patients' mobile devices, wearables and web searches, researchers are able to see the wider context of each patient's story.

This can lead to highly personalised care, improving relationships between patients and practitioners, offering bespoke data-driven advice, and making sure treatment fits into patients' lifestyles as seamlessly as possible.

Clinical trials likewise benefit from analytical systems, with apps and portals drawing on data from social media to engage with patients and track results. Despite the ready availability of this data, it's important for researchers to consider the fact that online interaction varies drastically depending on the age of each patient, and the stage and severity of their illnesses. As the current digitally-driven generation outlives its predecessors, however, this is likely to change, making social data a key indicator of patients' lifestyles and needs across the board.

This makes it more important than ever to raise awareness about the benefits of big data in healthcare. Many patients may be hesitant to consent to their data being used, yet the more data physicians have access to, the more informed diagnoses they can make. By being entirely transparent about data use and privacy, practitioners can help shift patients' perceptions about big data, improving and accelerating healthcare's digital revolution.

Connected Hospitals

Patients are rapidly becoming accustomed to having their day-to-day lives and preferences recorded in real time – and this doesn't stop when it comes to hospital care. The Internet of Things (IoT) is responsible for a significant growth in 'smart' devices and sensors that communicate with one another, gathering information and instantly reacting to it.

This technology is driven by data, with devices comparing patient input to statistical norms in order to help physicians make decisions. However, smart sensors and devices also generate data as they go, logging readings from each individual in order to create a streamlined, patient-centric experience.

This level of connectivity means that sensors placed on patients' bodies can seamlessly communicate with life-support systems and hospital infrastructures alike, recording vital signs and alerting caregivers about any changes in condition.

Connecting hospitals means connecting patients, giving them access to the very latest information about their conditions, and allowing them to participate in decisions about their care. Connected medical devices can send regular updates to patient apps, allowing them to monitor their own vital signs and ask practitioners informed questions should any concerns arise.

This level of patient involvement could have a significant effect on healthcare costs, avoiding unnecessary readmissions and helping practitioners to spot irregularities and pre-emptively combat issues before they become more serious and costly.

Perhaps more importantly, wearable sensors and IoT devices offer caregivers a chance to interact with patients in innovative, convenient and consistent ways, developing meaningful relationships even when face-to-face care is not possible or necessary.

In fact, a survey conducted by the American Academy of Family Physicians found that the overall majority of patients preferred home-based care to hospital care, citing comfort and convenience as well as relationships with physicians as key factors for their decision.[8]

For example, apps and wearables trialled on in-home monitoring of chronic obstructive pulmonary disease patients4 were able to accurately track weight changes in patients as they went about their day-to-day lives, notifying them and their caregivers of any unusual fluid retention.

This allowed patients to remain at home during treatment, learning to manage their own diseases with the assistance of trustworthy data-driven reminders. Likewise, caregivers were able to cut down on hospital costs while nonetheless closely monitoring patients' conditions, administering preventative care and treatment before hospitalisation was necessary.

Value-based Care

Healthcare costs are a significant concern for patients at any stage of illness, and it's important for healthcare staff to work together to offer as much value as possible to patients' experiences. Big data can assist caregivers in this mission by ensuring coordinated and consistent care, based on the latest trends and information available.

US insurers and public health systems such as Medicare and Medicaid are already promoting value-based and data-driven healthcare[10], through compensation systems that reward meaningful use of electronic health records. Research shows that 44% of healthcare providers consider this a significant driving factor in investing in big data.[11]

In order to meet these conditions, healthcare practitioners are required to reassess their reporting, data management, and process automation to ensure that their patient care is top-quality and cost-effective. This will affect patients directly, ensuring complete transparency in healthcare delivery and billing, and ensuring that care is efficient and price-conscious. US insurers' move away from fee-for-service compensation will hopefully set a precedent for global healthcare providers to invest in digital solutions and capitalise on big data while improving patient outcomes.

Facilitating Big Data in Healthcare

With the amount of healthcare data growing at 48% per year,[7] healthcare providers need access to the most cutting-edge analytics capabilities, in order to translate this wealth of data into valuable insights about patient care and engagement. This requires significant updates to IT infrastructures, making them more powerful and scalable, anticipating continued growth in the amount of data processed.

This is a significant challenge in the implementation of clinical data analysis, with 45% of organisations surveyed claiming that combining different types of data had caused them problems, and 37% citing difficulties in effectively managing volumes of data.[13]

Taking cues from the wider business world, healthcare professionals could benefit from the emerging trend of data lakes, which provide powerful architecture in which vast quantities of both raw and transformed data can be stored in a single location in multiple formats.

This would not only reduce the number of data silos across healthcare organisations, leading to inefficient analysis and potential for lost or misinterpreted information, but would also allow for effective and efficient cross-data analysis. By interconnecting data from a number of trusted external sources such as wearables, fitness devices, and medical devices on the IoT, data lakes will allow clinical teams to amass rich pools of data for each patient under their care, reducing complications in care, delivering personalised treatments, and improving the safety of clinical trials.

Open source data storage and analysis application, Hadoop, was developed by Yahoo, based on research by Google.[14] Using powerful algorithms, it automatically divides large data queries into many more manageable parts, processing these individually via different nodes, and then combining the results for analysis.

This will give researchers across the globe access to data sets that were previously impossible for their infrastructures to handle, opening up entire new research domains for exploration. This functionality will also allow analytics to become more forward-focussed and accurate in their predictions, helping healthcare providers to create a continuous learning environment that reacts to every trend and innovation.

Safeguarding

One of the most significant concerns about healthcare's growing reliance on big data regards safeguarding. As medical data is amongst an individual's most personal information, researchers

need to ensure that this information is only seen by those whom patients have agreed to share it with.

Medical data is highly valuable to cyber thieves, who reportedly make more money from stealing and abusing health data than they do from credit card details.[15] In 2015 alone, 750 medical data breaches occurred,[16] including the theft of 80 million patient records from healthcare insurer Anthem.[17]

While this attack focussed on gleaning identity data from patients rather than exposing data on illnesses and treatments, patients are understandably concerned about the digitisation of their medical information – and putting patients' minds at ease about their privacy is a significant part of providing patient-centric care.

Currently, an approximate 91% of cyber attacks come from phishing emails,[18] luring professionals into clicking links and downloading compromising viruses. Healthcare professionals therefore need thorough training in computer literacy, with a particular focus on security. Spreading this knowledge and regularly updating training as cyber crime trends develop will pre-emptively counter further attacks of this nature. The FDA has also issued new guidelines on data security over the past two years, updating them to reflect the diversity of medical devices and apps.

As well as calling for tighter security measures on connected devices and apps before they come to market, the guidelines focus on developing stronger channels of communication between device manufacturers and the practitioners who use them, ensuring that vulnerabilities discovered later down the line can be quickly fixed.

In fact, greater levels of communication can be seen as a crucial aspect of healthcare's digital transformation, pairing innovation with complete transparency to ensure that the risks of big data don't outweigh the benefits it offers the world of healthcare.

Conclusion

Already, research from CDW Healthcare[19] shows that 82% of organisations that have implemented big data analytics have reported improved patient care, while 63% report reduced admission rates and 62% claim improved overall health outcomes.

With such significant yields already being seen, the big data revolution doesn't seem to be slowing down. We can look at the Electronic Medical Records programme in Denmark[20] for a glance at future successes: this nationally-implemented big data model has grown exponentially since its introduction in 2007, amassing 1.2 million entries by 2011, a significant proportion of which were supplied by patients themselves.

This has provided a solid foundation for decision-making, and provided patients with easy and empowering access to their own health information. As much as these trends provide encouragement for healthcare organisations experiencing their own digital transformations, it's the future we must focus on now: as patients become accustomed to the use of apps, wearables and IoT devices in their day-to-day lives, they will directly feed into their own patient care, and to the improvement of outcomes across the system.

By becoming more involved in their own healthcare decisions, patients can actively contribute their experiences to the ongoing pool of information used by physicians across the globe to diagnose illnesses, plan and execute treatments, and offer patients extra value. Big data doesn't just put patients at the centre of their own healthcare experiences. It puts them at the heart of the entire industry.

REFERENCES

1. J. Manyika et al, "Big data: The next frontier for innovation, competition, and productivity", 2011, retrieved from http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/big-data-the-next-frontier-for-innovation
2. Pharmaceutical companies that digitize grow more" retrieved from https://www.accenture.com/us-en/insight-highlights-life-sciences-pharmaceutical-grow
3. Big Data, for better or worse: 90% of world's data generated over last two years", 2013, retrieved from https://www.sciencedaily.com/releases/2013/05/130522085217.html
4. Accelerating the evolution of human care", retrieved from http://www.oracle.com/us/industries/health-sciences/healthcare-analytics-info-2660933.pdf
5. Robots and Research: The Future of Drug Discovery", retrieved from https://mdgroup.com/en/news/robots-and-research-the-future-of-drug-discovery/
6. A. Azvolinsky, "Antidepressants Could Treat Small-Cell Lung Cancer" retrieved from http://www.cancernetwork.com/lung-cancer/anti-depressants-could-treat-small-cell-lung-cancer
7. K. Conger, "Big data = big finds: Clinical trial for deadly lung cancer launched by Stanford study" retrieved from http://scopeblog.stanford.edu/2013/09/27/big-data-big-finds-clinical-trial-for-deadly-lung-cancer-launched-by-stanford-study/ Patients Prefer Home vs. Hospital Care for Acute Illness" 2006, retrieved from http://www.aafp.org/afp/2006/1215/p2109.html
8. B. Celler, N. Lovell, J. Basilakis, "Using information technology to improve the management of chronic disease", 2003, retrieved from https://www.mja.com.au/journal/2003/179/5/using-information-technology-improve-management-chronic-disease?inline=true
9. Medicare & Medicaid EHR Incentive Program", retrieved from https://ehrincentives.cms.gov/hitech/login.action
10. D. Mareco, "How to optimise patient care: the growth of big data in healthcare", retrieved from http://www.securedgenetworks.com/blog/how-to-optimize-patient-care-the-growth-of-big-data-in-healthcare-infographic
11. R. Leventhal, "Report: Healthcare Data is Growing Exponentially, Needs Protection", 2014, retrieved from https://www.healthcare-informatics.com/news-item/report-healthcare-data-growing-exponentially-needs-protection
12. D. Mareco, "How to optimise patient care: the growth of big data in healthcare
13. J. Crapo, "Hadoop in Healthcare: A No-nonsense Q and A", retrieved from https://www.healthcatalyst.com/Hadoop-in-healthcare
14. C. Humer, J. Finkle, "Your medical record is worth more to hackers than your credit card", 2014, retrieved from http://www.reuters.com/article/us-cybersecurity-hospitals-idUSKCN0HJ21I20140924
15. Why Data Security is The Biggest Concern of Health Care", retrieved from http://healthinformatics.uic.edu/resources/articles/why-data-security-is-the-biggest-concern-of-health-care/
16. B. Herman, "Details of Anthem's massive cyberattack remain in the dark a year later", 2016, retrieved from http://www.modernhealthcare.com/article/20160330/NEWS/160339997
17. A. Savvas, "91% of cyberattacks begin with spear phishing email", 2012, retrieved from
18. http://www.techworld.com/news/security/91-of-cyberattacks-begin-with-spear-phishing-email-3413574/
19. D. Mareco, "How to optimise patient care: the growth of big data in healthcare
20. Ehealth in Denmark", retrieved from http://www.sum.dk/~/media/Filer%20-%20Publikationer_i_pdf/2012/Sundheds-IT/Sundheds_IT_juni_web.ashx

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