Could Big data save Global Healthcare?

Samuel Thomas

March 29, 2023

1 Introduction

Big data[1] has become a rising star that could transform how healthcare functions in the modern world. Societies' always-on[2] nature has meant that personal data is constantly being produced from our electronic devices. Because of this, we have more diverse information at our fingertips such as Personal Health[3], our day-to-day movements[4], shopping habits, and lifestyle choices. The need for healthcare to rely on events such as the census[5] is potentially fading away. Big data could be the key to driving a more efficient and reliable healthcare service worldwide.

1.1 The Current State of Healthcare

As our world population rises to new heights (8 Billion March 2023) so does global demand. Struggling to keep up, healthcare is one of the many essential services being left behind.

It is estimated that in the U.S. 251,000 deaths occur annually[6] due to medical errors, accounting for 9.5%[6] of all deaths in the U.S. Medical errors are becoming a common theme for doctors and clinicians, too often they are too quick to make assumptions and unable to fix mistakes; leaving healthcare over 75% more compliant[6] with medical errors.

As average waiting times in healthcare increase, successful patient outcomes decrease. You can expect to wait between 2-18 weeks[7] for an NHS appointment, and often not be given a solution. This culminates in a chain of appointments where patients progress through the healthcare system; leaving patients with worsening health outcomes, and healthcare with an ever-increasing backlog of appointments. Patients' confidence in healthcare systems is decreasing as healthcare infrastructure fails them[8].

Healthcare is at a tipping point, unable to cope with the current climate, healthcare must adopt data-driven practices. The advancement and integration of Big data would allow healthcare to become more efficient and reliable, potentially allowing it to thrive in the new data-driven world.

2 What Changed?

2.1 Cloud Computing

The integration of cloud computing[9] in the modern world has provided effective solutions for storing and processing vast amounts of data securely, centrally, and at a lower cost. Introducing Big Data into healthcare presents the issue of storing vast amounts of data; cloud computing has removed this issue. Cloud computing has also aided medical and healthcare teams in providing access to simplified medical data and information[10]. Data about patients and demographics can be processed off-site dynamically, allowing physicians to obtain fast answers and prescribe correct, and effective treatment. High-level collaboration between physicians[10] is also facilitated by cloud computing. Doctors and clinicians can now base their judgements on a detailed patient electronic health record stored[11] on the cloud; reducing the risk that not all factors are considered. Thus, potentially reducing the chains of physicians a patient must see to be treated successfully.

2.2 The Adoption of Smart Devices

Smart wearable devices such as Fitbits and Apple watches have emerged as powerful tools for collecting personal health information such as a patient's heart rates, sleep patterns, and activity levels. When combined with machine learning[12] and mathematical distributions this data provides doctors and clinicians with an insight into a patient's life. Helping to identify potential health risks, areas of concern, and what their day-to-day life is like. Therefore, access to Big data helps unlock prior knowledge[3] about patients, revolutionizing how doctors and clinicians function. Patients with chronic health conditions[13] are those who are currently most impacted by Big data. Doctors can monitor patients with heart disease, diabetes and asthma without having to be present. The monitoring of these patients allows doctors to accumulate vast amounts of data, potentially allowing them to adjust treatment plans following an initial trial and, prevent other medical events from occurring.

Smart inhalers[14] are one of these devices; each time a patient uses their inhaler the GPS location, time, length and amount are recorded. This, combined with other personal data, provides feedback to patients on when they should use their inhalers for the best results. Thus, feedback on usage has been shown to improve patient adherence and competence by over 10%[14] when compared to traditional inhalers; making patients less at risk of asthma attacks.

Advancements in accessing personal data have allowed healthcare services a better understanding of patients and their demographic before initial treatment. Enabling real-time care to have a more accurate and effective treatment and subsequently less chance of misdiagnosis.

3 What Now?

Predictive analytic healthcare is a predominant field in the discussion of Big data and healthcare. Using advanced analysis of Big data we can determine whether a patient or population is at risk of illness. Cancer[15] being one of these illnesses; it is one of many unsolved diseases in healthcare and must be managed effectively to have the best outcome. Population management focuses on directing intervention[15] at high-risk patients, to avoid poor outcomes and provide support. Big data facilitates predictive analytic algorithms in identifying high-risk cancer patients. Intervention has the potential to curb the overuse of healthcare resources[15]; allowing other patients access to medical treatment, while relieving pressure on healthcare services. Predictive analytics allows radiomics in oncology to better detect cancerous tumors. Algorithms using Big data can simulate a suspected tumor to determine whether it will become cancerous. Physicians can now potentially detect early signs of cancer and, subsequently have more informed decisions when delivering care. Along with simulating tumors, pathologists can use predictive analytics to accurately identify cancerous cells. Reducing the risk of pathologists interpreting samples differently; thus, improving the workflow of pathologists and the early detection of cancer. Ultimately, predictive analytics has been shown to help healthcare detect cancer earlier[15], improve the outcome of patients, and reduce the number of cancer patients being misdiagnosed.

4 What the Future might look like?

By adding big data analytics into the healthcare sector, it is predicted that at least 300–450 billion dollars a year could be saved by healthcare industries[10] through, improved prediction, diagnosis, and treatment. Personalised treatment plans and real-time monitoring of individuals could become the future of modern healthcare, saving healthcare from falling behind any further. Despite this, all these benefits are reliant on a constant source of accurate data. Healthcare industries must gain access to vast amounts of personal data; posing the issue that patients may not be willing to give this information away. Following the NHS data leaks[16] of 2017, 2018, and 2019, they have lost patient confidence. Leaks such as these cost healthcare industries millions of dollars. If healthcare services like the NHS were to start adopting a highly data-driven approach, they would need to ensure correct GDPR[17] practices are followed. Furthermore, the risk of additional data leaks, with the integration of Big data, could leave healthcare industries in a position of no return, rather than rescuing it. Potentially outweighing the benefits that Big data provides.

References

[1] Z. A. Al-Sai, R. Abdullah, and M. h. husin, "Big data impacts and challenges: A review," in *2019 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT)*, pp. 150–151, 2019.

[2] N. S. Baron, *Always On: Language in an Online and Mobile World*. Oxford University Press, 04 2008.

[3] S. Wang, J. Yuan, and C. Pan, "Impact of big data resources on clinicians' activation of prior medical knowledge," *Heliyon*, vol. 8, no. 9, p. e10312, 2022.

[4] Z. Li, X. Li, D. Porter, J. Zhang, Y. Jiang, B. Olatosi, and S. Weissman, "Monitoring the spatial spread of covid-19 and effectiveness of control measures through human movement data: Proposal for a predictive model using big data analytics," *JMIR Res Protoc*, vol. 9, p. e24432, Dec 2020.

[5] O. for National Statistics, "About the census," 2023.

[6] F. Lau, J. Bartle-Clar, and G. Bliss, *Building Capacity for Health Informatics in the Future*. Studies in Health Technology and Informatics, IOS Press, 2017.

[7] NHS, "Guide to nhs waiting times in england," 2023.

[8] A. Naidu, "Factors affecting patient satisfaction and healthcare quality," *International Journal of Health Care Quality Assurance*, vol. 22, 2009.

[9] E. Knorr and G. Gruman, "What cloud computing really means," *InfoWorld*, vol. 7, no. 20-20, pp. 1–17, 2008.

[10] L. Rajabion, A. A. Shaltooki, M. Taghikhah, A. Ghasemi, and A. Badfar, "Healthcare big data processing mechanisms: The role of cloud computing," *International Journal of Information Management*, vol. 49, pp. 271–289, 2019.

[11] S. Dash, S. K. Shakyawar, M. Sharma, and S. Kaushik, "Big data in healthcare: management, analysis and future prospects," *Journal of Big Data*, vol. 6, no. 1, pp. 1–25, 2019.

[12] A. Jung, "Machine learning: Basics," in *Machine Learning.*, pp. 1 – 18, 2022.

[13] H. S. Bernell S, "Use your words carefully: What is a chronic disease?," *Front Public Health*, 2016.

[14] C. Zabczyk and J. D. Blakey, "The effect of connected "smart" inhalers on medication adherence," *Frontiers in Medical Technology*, vol. 3, 2021.

[15] R. B. Parikh, A. Gdowski, D. A. Patt, A. Hertler, C. Mermel, and J. E. Bekelman, "Using big data and predictive analytics to determine patient risk in oncology," *American Society of Clinical Oncology Educational Book*, vol. 39, no. 39, pp. e53–e58, 2019. PMID: 31099672.

[16] S. Gold, "Securing the national health service," *Computer Fraud and Security*, vol. 2010, no. 5, pp. 11–14, 2010.

[17] N. Clarke, G. Vale, E. P. Reeves, M. Kirwan, D. Smith, M. Farrell, G. Hurl, and N. G. McElvaney, "Gdpr: an impediment to research?," *Irish Journal of Medical Science (1971-)*, vol. 188, pp. 1129–1135, 2019.