Our Next Steps to Digitalization:

How can the current problems in healthcare be minimised using AI and technology?

Sarah Mackel

Secondary School Pupil

International School of Luxembourg

Word Count, excl. title page and references: 1497

The Unofficial Guide to Medicine Essay Competition

Introduction

The rising demand for medical tests and consultant insight is straining our current model of medical practice: while primary care providers are under increasing stress, A&E is failing to meet its target waiting times; workforce shortage increases, but so does demand for medical scans. Consequently, doctors are more prone to misdiagnosis and misprescription, which harms patients. So, the need for an efficient solution is growing more obvious by the day.

This is where artificial intelligence (AI) comes into play. AI predicts patterns by forming algorithms from massive amounts of data, assisting in diagnostics, monitoring patient records, and triaging patients before GP visits. Moreover, AI apps can track a patient's health markers from their mobile phone. AI software holds great clinical potential, which begs the question of how AI and technology can minimise current problems in healthcare.

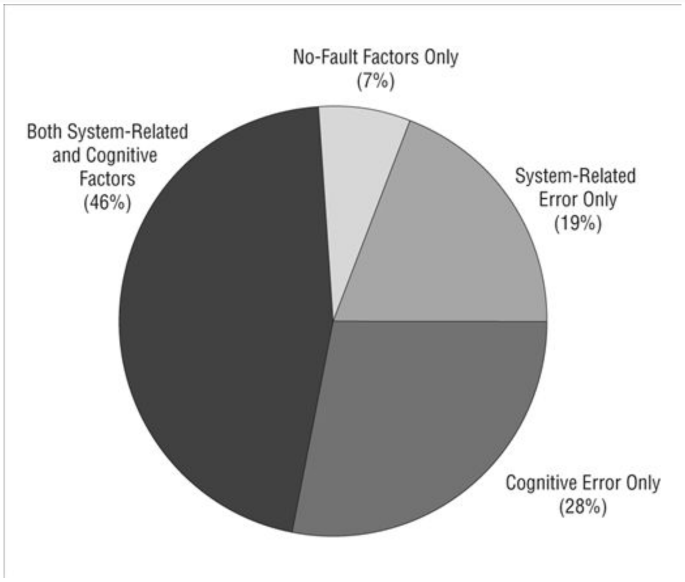
In this essay, I aim to define the most relevant and affordable ways to apply AI to a clinical setting in order to alleviate the current pressure on the NHS.

Defining AI

Oxford Reference defines AI as "the theory and development of computer systems able to perform tasks normally requiring human intelligence"[1]. This essay will focus on a branch of AI called Machine Learning (ML), a self-adaptive algorithm that improves at pattern recognition as it receives data[2]. I will specifically examine clinical benefits of Evidence-Adaptive Clinical Decision Support Systems (EA-CDSS)[3], which apply AI to evidence-based medicine, the examination of data to inform clinical decisions and suggest diagnoses, by using ML to adapt to changes and tailor healthcare to the patient.

This essay recommends that a centralised NHS clinical data bank combined with CDSS's and specialized applications can minimize the current problems facing healthcare in the UK.

AI and Diagnostic Error/Bias



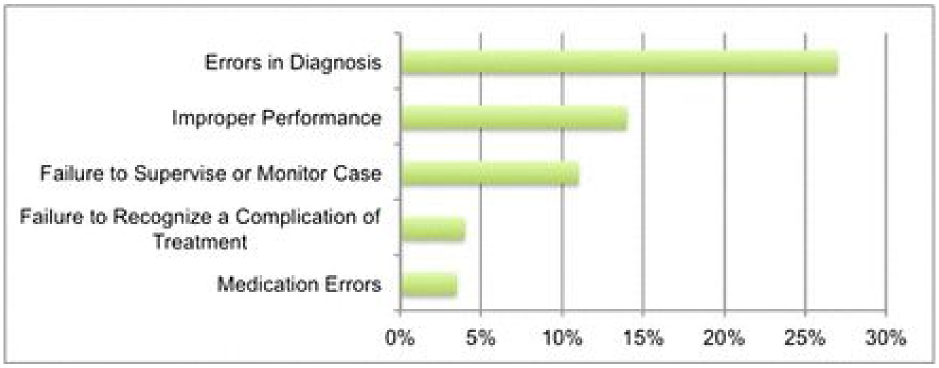
Firstly, AI remedies human cognitive error in diagnosis. This chart[4] shows human cognitive errors compared to system-related errors in misdiagnosis. Cognitive error accounts for 74% of cases[4]: fatigued doctors seek simple solutions or stereotype; AI could solve this problem as it is indefatigable and only draws conclusions from features of the data presented to it.

These very features, however, could create unwitting bias in AI: For example, algorithms fed predominantly light-skinned melanoma images have trouble diagnosing melanoma on darker skin[5], showing that diversity of data is imperative in achieving diagnostic accuracy.

Negligence Claims

Such increase in diagnostic accuracy will lead to fewer medical mistakes.

Negligence claims are legal claims filed due to misdiagnosis or failure to properly monitor a case; in 2019, the NHS paid out an approximate £2.4 billion in these claims[6], which will continue to increase by 11.5% per year[7]. As this US-based chart shows, diagnostic error and failure to monitor a case account for 38% of all negligence claims resulting in patient death[8], which could be lowered by multidisciplinary CDSS-aided diagnostic teams.

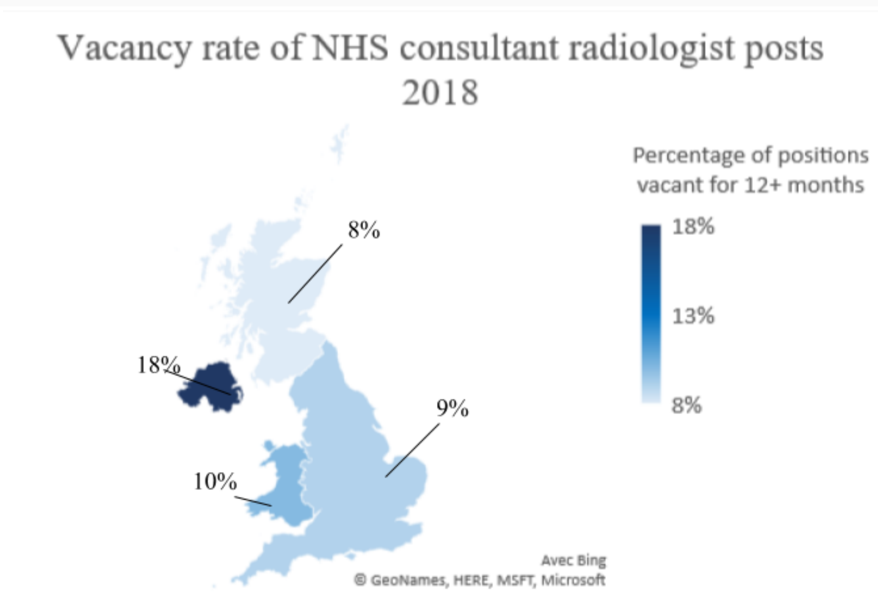


These arguments lend to the claim that AI can support diagnostic accuracy and streamline the medical practice. Yet, if we use AI for high-risk clinical situations, do incremental benefits to its intelligence compensate for the risk of failure?

AI Imaging Interpretation

The King's Fund estimates 100,000 NHS staff vacancies as of March 2019, "threatening the ability of the service to deliver safe, high-quality care"[9].

There is a specific shortage of radiologists: 2018 saw 379 unfilled consultant radiologist positions in the UK[9], causing the NHS to spend £165 million on outsourcing and overtime to compensate, as only 2% of UK radiology departments fulfilled their reporting requirements within contracted hours in 2018[11]. Despite this, demand for complex imaging scans such as MRIs still increases by 13% a year[12]; the Royal College of Radiologists estimates that the number of radiology training positions consequently needs to triple from 265 to 808 to compensate[10].



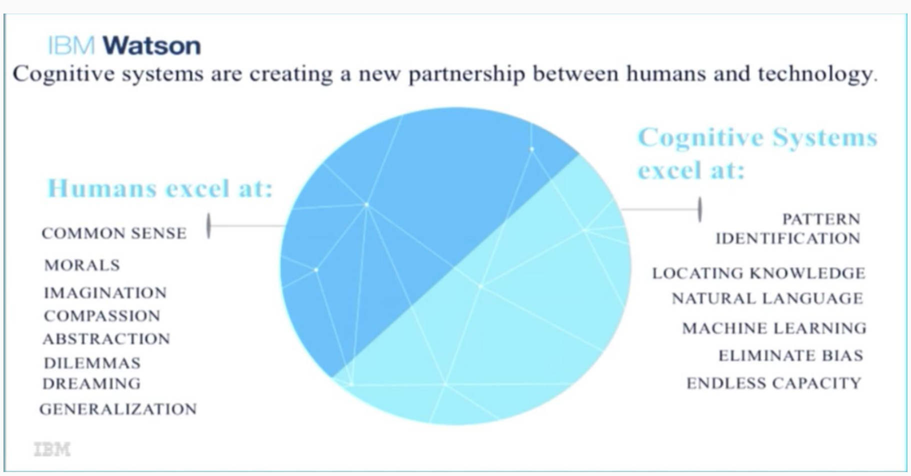
Well-trained AI programs could remedy this predicament: for example, the AI company DeepMind has developed optometric AI capable of diagnosing 50 different eye diseases with 94.5% accuracy through OCT scans[13], surpassing optometry experts. Similarly, VidaLung has developed AI capable of identifying minute abnormalities from a CT scan[14], showing how AI could remedy our shortage of radiologists.

Case Study 1: IBM Watson Health

An example of a company applying AI to medicine is IBM Watson[15], a USA-based company that uses AI to process clinical imaging and other data to aid diagnostics. Through software called Natural Language Processing (NLP), IBM's AI forms algorithms from unstructured, unlabeled data.

The Watson Imaging Clinical Review[16], for example, keeps patient problem lists up-to-date and automatically reconciles the said list with the patient's clinical evaluation and recorded diagnoses, to alert the reader of discrepancies in patient records. Similarly, the Watson Patient Synopsis[17] extracts patient data from their electronic health records and provides a summary view of their case; its goal is to provide an in-context presentation to improve and personalise clinical decisions. AI such as this could furthermore popularise personalised medicine by putting treatment and diagnosis in the context of any data gathered from the patient, such as history, genome, and symptoms[18].

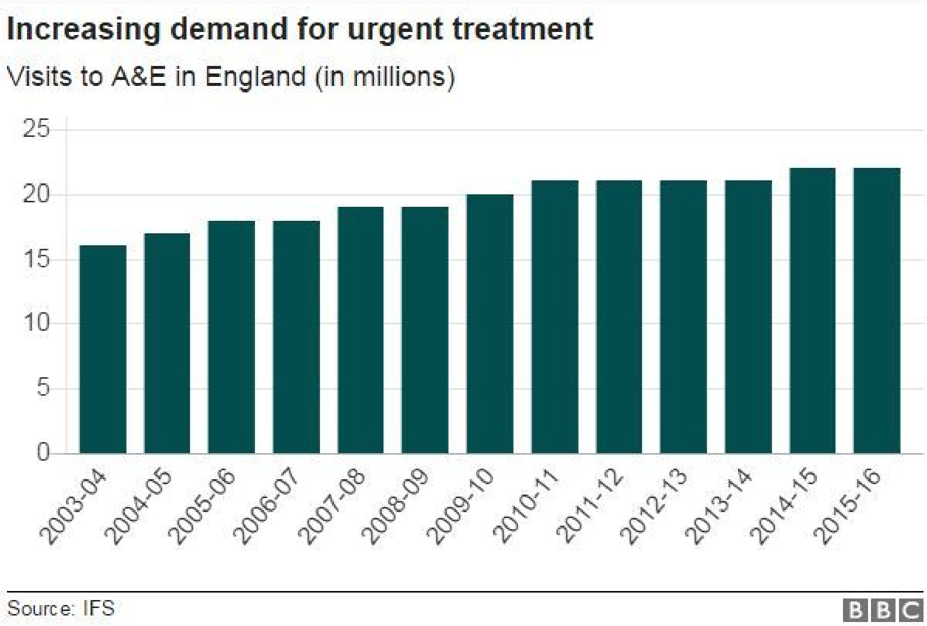
These programs are the beginning of a symbiosis between humanity and AI in hospitals: While AI systems will streamline hospital practice by identifying patterns to aid diagnosis and monitoring information through electronic patient records, doctors will have more time to connect to patients and provide much-needed empathy.



Case Study 2: Babylon

Aside from use in hospitals, AI can also benefit primary care providers. For example, Babylon GP at Hand is an online GP service offering 24/7 medical advice, triage questionnaires, and health trackers through a phone app[19]. Babylon's symptoms-checker chatbots inform patients whether they should seek consultation at one of the company's practices. Similar video-call consultations and online services could greatly reduce waiting times for GP appointments and help any mobility-impaired patients who have trouble leaving their homes.

In the future, the NHS could develop and standardize chatbot apps similar to Babylon's to avoid unecessary doctor's visits as primary care providers and A&E are currently swamped by patient influx and struggling to meet their target wait times: in 2018-19, just under 3 million patients spent longer than 4 hours in A&E[20], or 12% of the total patient influx. Moreover, the NHS set out to diagnose 95% of suspected cancers within 28 days of GP referral by 2020 but this too failed in 2019[21].



This may be due to 2,000,000 urgent GP referrals in 2018[22] and increasing demand for A&E treatment (see chart[23]). Easily-accessible home tests such as Lung Health Check[24], FIT[25], and a new AI-powered screening test for dementia[26] will help to streamline screening and reduce GP referrals and A&E waiting times. Chatbots could also be an alternative to the NHS's 111 non-emergency phone line, which is often overcrowded[27], and symptom-tracking apps like Migraine Buddy could monitor patients' symptoms, reducing the need for follow-up appointments. Overall, medical AI applications will allow access to higher-quality care, and allow medical care to become more widely accessible.

Possible Health Concerns

However, while such apps could make healthcare more accessible, constant health monitoring could worsen conditions like orthosomnia, hypochondria, or eating disorders. For example, on any FitBit, we can log every calorie we consume[28]; patients with disorders like *anorexia nervosa* and *orthorexia nervosa*, of which compulsive calore-counting is a symptom, could suffer from this kind of monitoring, which the NHS should take into account when implementing health-tracking software.

How realistic are these solutions?

Data Banks

For CDSSs to work, all medical data and records must be digitalized. A current challenge facing the application of AI imaging in healthcare is the availability of data to machines, as patients' medical data is private. NHS radiologist Hugh Harvey has suggested the implementation of a centralised medical data trust containing mass quantities of anonymised data, of which the NHS would be in full control[29]. Like data from Radiopaedia[30] and the Trial Bank[31], this data would be available to any researchers as training data on which to model medical AI algorithms. The larger quantity of data would reduce the aforementioned AI biases due to the diversity of the source.

Questions

The above points, however, raise an ethical concern: should insurance companies have access to genomic data or discriminate against high-risk patients?

Additionally, with an increasing population of seniors, can we be sure that they are able to use the suggested technology?

Conclusion

This essay has suggested uses for AI in healthcare by examining the nature of CDSS's and emerging solutions to problems in the NHS, and has raised questions on AI and personalized medicine.

In conclusion, the most affordable and relevant way to apply AI to the NHS would be through mass digitalization of healthcare data and application of diagnostic AI in clinical care, which would make up for NHS workforce shortage, lower AI bias, and reduce overcrowding. This essay has shown that the integration of AI will build a more efficient, more sustainable model of medical practice.

References

1. "Artificial Intelligence - Oxford Reference." *Artificial Intelligence - Oxford Reference*, Oxford Reference, 31 Oct. 2019, https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095426960.

2. Saria, Suchi. "TEDxBoston." TEDxBoston. 12 Oct. 2016. https://www.youtube.com/watch?v=Nj2YSLPn6OY

3. El-Masri, Samir, et al. *An Adaptive Evidence Based Medicine System Based on a Clinical Decision Support System* . vol. 4, Faculty of Computers & Information, Mansoura University, 2012.

4. Graber, Mark L., et al. "Diagnostic Error in Internal Medicine." Archives of Internal Medicine, vol. 165, no. 13, Nov. 2005, p. 1493., doi:10.1001/archinte.165.13.1493. https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/486642

5. Lashbrook, Angela. "AI-Driven Dermatology Could Leave Dark-Skinned Patients Behind." *The Atlantic*, Atlantic Media Company, 16 Aug. 2018, https://www.theatlantic.com/health/archive/2018/08/machine-learning-dermatology-skin-color/567619/.

6. "NHS Paid out £2.4 Billion in Clinical Negligence Claims Last Year." *Wiseman Lee*, 17 July 2019, https://www.wiseman.co.uk/nhs-paid-2-4-billion-clinical-negligence-claims-last-year/.

7. Kayll, Simon. *The Rising Cost of Clinical Negligence: Who Pays the Price?*

Medical Protection Society, n.d., pp. 10–11.

8. Graber, Mark. (2013). The incidence of diagnostic error in medicine. BMJ quality & safety. 22. 10.1136/bmjqs-2012-001615.

9. West, Michael. "The NHS Crisis of Caring for Staff." *The King's Fund*, 1 Mar. 2019, https://www.kingsfund.org.uk/blog/2019/03/nhs-crisis-caring.

10. "The NHS Does Not Have Enough Radiologists to Keep Patients Safe, Say Three-in-Four Hospital Imaging Bosses." Royal College of Radiologists, 4 Apr. 2019, https://www.rcr.ac.uk/posts/nhs-does-not-have-enough-radiologists-keep-patients-safe-say-three-four-hospital-imaging.

11. *Clinical Radiology UK Workforce Census 2018 Report*. Royal College of Radiologists, 2019, p. 4

12. "NHS Must Do More to Future-Proof Its MRI Capacity, Say Imaging Experts." *Royal College of Radiologists*, Royal College of Radiologists, 10 May 2017, https://www.rcr.ac.uk/posts/nhs-must-do-more-future-proof-its-mri-capacity-say-imaging-experts.

13. Shead, Sam. "Google DeepMind's AI Can Detect 50 Eye Disease Conditions And Save Sight." *Forbes*, Forbes Magazine, 13 Aug. 2018, https://www.forbes.com/sites/samshead/2018/08/13/google-deepminds-ai-can-detect-50-eye-disease-conditions-and-save-sight/#3adb22b127f3.

14. "Transforming Lung Care in the Age of Intelligence." *VIDA*, https://vidalung.ai/.

15. "Artificial Intelligence in Medicine: Machine Learning." *IBM*, IBM Watson Health, https://www.ibm.com/watson-health/learn/artificial-intelligence-medicine.

16. "Watson Imaging Clinical Review." *Watson Imaging Clinical Review - Overview - United States*, IBM Watson Health, 29 Dec. 2019, https://www.ibm.com/us-en/marketplace/watson-imaging-clinical-review.

17. "IBM Watson Imaging Patient Synopsis - Overview." *IBM*, IBM Watson Health, https://www.ibm.com/products/watson-imaging-patient-synopsis.

18. "IBM Watson for Genomics." *IBM Watson for Genomics - Overview - United States*, 30 Dec. 2019, https://www.ibm.com/us-en/marketplace/watson-for-genomics.

19. *NHS Choices: Babylon GP at Hand*, NHS, https://www.gpathand.nhs.uk/.

20. Baker, Carl. "NHS Key Statistics: England, October 2019.", House of Commons Library, 2019, p. 5.

21. Underwood, George. "NHS given 28-Day Cancer Diagnosis Target." *PharmaTimes*, PharmaTimes Media Limited, 14 Sept. 2015, http://www.pharmatimes.com/news/nhs_given_28-day_cancer_diagnosis_target_971890.

22. *Annual NHS Cancer Checks Top Two Million for the First Time*. NHS England, 23 Apr. 2019, https://www.england.nhs.uk/2019/04/annual-nhs-cancer-checks-top-two-million-for-the-first-time/.

23. Triggle, Nick. "10 Charts That Show Why the NHS Is in Trouble." *BBC News*, BBC, 24 May 2018, https://www.bbc.com/news/health-42572110.

24. "About the Lung Health Check." *Manchester Health & Care Commissioning*, NHS Manchester University Foundation Trust, https://mft.nhs.uk/lunghealthcheck/about-the-lung-health-check/.

25. Richter, James. "Just Do It... Yourself: At-Home Colorectal Cancer Screening." *Harvard Health Blog*, 11 Mar. 2019, https://www.health.harvard.edu/blog/just-do-it-yourself-at-home-colorectal-cancer-screening-2019031216183.

26. Hughes, Owen. "Using AI Assessment to Tackle Dementia in Ultra-Early Stages." *Digital Health*, 10 Sept. 2019, https://www.digitalhealth.net/2019/09/using-ai-assessment-tackle-dementia-ultra-early-stages/.

27. Donnelly, Laura. "NHS 111 Calls Handling Provider Warned over Slow Response Times." *The Telegraph*, Telegraph Media Group, 27 Mar. 2016, https://www.telegraph.co.uk/news/2016/03/27/nhs-111-calls-handling-provider-warned-over-slow-response-times/.

28. "How Do I Track My Food with the Fitbit App?" *Fitbit Help*, https://help.fitbit.com/articles/en_US/Help_article/1375/?l=en_US&c=Topics:Food_Calories&fs=Search&pn=1.

29. Harvey, Hugh. “UK Can Lead in Radiology AI. Here's How...” *Medium*, Medium, 16 Jan. 2018, https://medium.com/@DrHughHarvey/uk-can-lead-in-radiology-ai-heres-how-c4c98990d833.

30. “Radiopaedia's Mission Is to Create the Best Radiology Reference the World Has Ever Seen and to Make It Available for Free, for Ever, for All.” *Radiopaedia Blog RSS*, https://radiopaedia.org/.

31. “Summary of Trial Bank Project.” *Human Studyome*, http://rctbank.ucsf.edu/home/trialreporting/introduction.