Artificial intelligence in medical diagnostics, a review of NICE MedTech innovation briefings

Foster D, Ioannou P, Willits I

PHMR, Berkeley Works, London, UK

Objectives

Artificial intelligence (AI) used in medical diagnostics is growing rapidly. Diagnostic AI can facilitate improved triage and diagnosis, prioritise caseload, monitor physiology and chronic disease, and maximise diagnostic efficiency (1). Recently, NICE MedTech Innovation Briefings (MIBs) began to review AI technologies. MIBs summarise the best available published evidence for a technology and evaluate the strengths and weaknesses with expert opinions included on each technology (2). We identified AI technologies in MIBs and summarised the uncertainties and challenges its implementation faces.

Methods

A targeted review of the NICE website was conducted to identify MIBs featuring AI technologies. Data extracted included disease area, area of use, clinical outcomes, costs, and evidence strengths and limitations.

Table 1. The disease area and key evidence strengths and weaknesses of the AI technologies reviewed in the MIBS

	Technology name	Disease area	Key strengths of evidence	Key weaknesses of evidence
MIB243 [3]	Veye Chest Icolung Veolity	Respiratory conditions	A VeyeChest study was UK-based, which may help generalisability to the NHS	No studies published in full
MIB254 [4]	Butterfly iQ+	All disease areas	Two of five studies had comparators, but they did not report patient outcomes. One study was done in the UK	The evidence for the technology is of low to moderate methodological quality, and most of the studies have small patient numbers
MIB213 [5]	Lifelight First	Respiratory conditions	Real-world data obtained in the NHS	Unpublished manuscript, not peer reviewed
MIB262 [6]	Rapid AI	Cardiovascular	All studies are peer-reviewed publications	Retrospective accuracy analysis which increases the risk of selection bias alongside small population sizes and results not being generalisable to the NHS
MIB242 [7]	Transpara HealthMammo Software ProFound AI	Oncology	The evidence base is at an expected level for AI technologies emerging in the NHS	The evidence base contains exams of people with cancer, rather than a screening population
MIB243 [8]	Aidoc: head e-CTA/e-ASPECTS Icobrain qER Zebra triage	Neurology	A number of large, multicentre studies that address a relevant clinical outcome	A lack of randomised controlled trials assessing the effect of the technology on patient outcomes
MIB269 [9]	Immunoscore	Oncology	The evidence base includes over 4,000 people with stage 1 to 3 colon cancer	A lack of comparative data and of generalisability to the NHS
MIB267 [10]	HealthVCF	Musculoskeletal conditions	Large population within a large healthcare organisation across multiple centres	Limited evidence base
MIB265 [11]	EyeArt RetinaLyze Retmarker	Diabetes	UK evidence for all 3 technologies	Varied evidence quality and a lack of randomised controlled trials

Results

- Nine MIBs featuring AI were identified, covering 19 technologies. All were used in diagnostics or monitoring, with the most common application being computerised tomography (Figure 1). Disease areas covered included respiratory medicine, cardiovascular medicine, neurology, and oncology.
- The majority of the medical device classes associated with the technologies were class IIa (53%), followed by class I (37%) (Figure 2).
- Evidence used in the MIBs reported that all the technologies were effective, including improvements in performance and reduced time for interpretation of diagnostic information compared with human readers.
- However, considerable uncertainties regarding the informing studies were identified. The key strengths and weaknesses of the evidence presented in each MIB are shown in Table 1. These included use of small sample sizes and participants not representative of their intended population; poor methodological quality featuring retrospective analysis, increasing the risk of bias and confounding; and a lack of reference standards, meaning diagnostic accuracy data could not be ascertained. Additionally, many of the supporting studies were not published or peer-reviewed, casting further doubt on the robustness of their findings.
- Capital costs ranged from £1,699 to £80,000, and annual costs were as high as £90,000.
- Where costs were higher than standard care, AI had the potential to reduce resource use through decreased staff workload or improve clinical management through faster diagnosis (Figure 3).

Figure 3. The additional cost to the NHS from AI technologies may be balanced by factors such as decreased staff workload, faster diagnosis leading to improved outcomes and improved interpretation of diagnostic images, reducing the risk of false negatives and positives

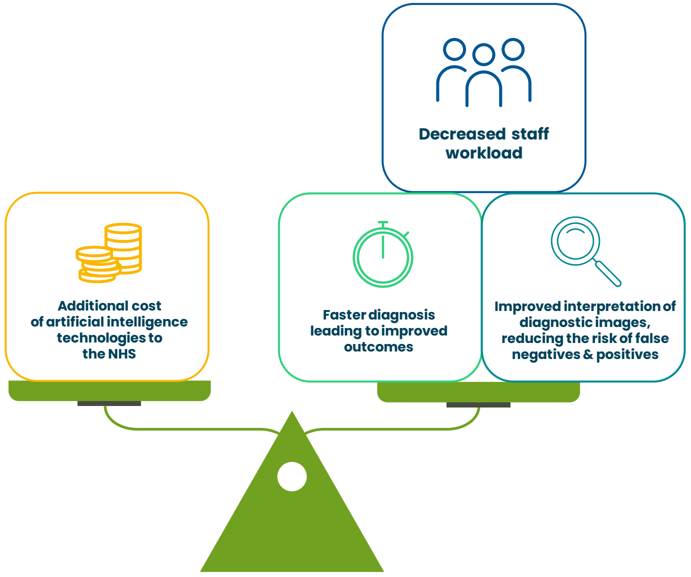


Figure 1. The areas of use of the AI technologies reviewed in the MIBs

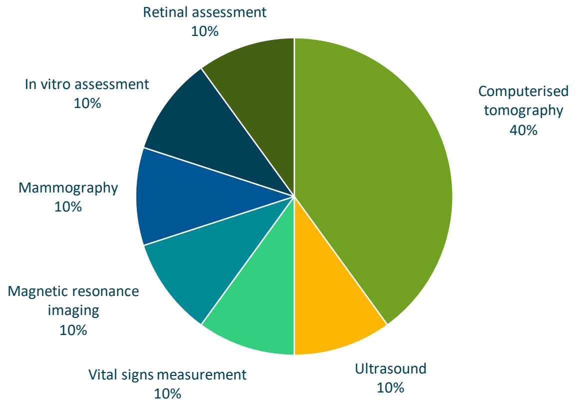
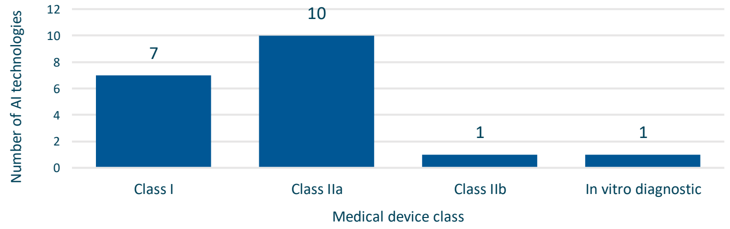


Figure 2. The medical device classes associated with the AI technologies reviewed in the MIBs



Conclusions

AI has the potential to improve diagnostic efficiency leading to benefits in the patient pathway, which could release healthcare resources. Going forward, a key challenge for diagnostic AI will be to improve the quality of the supporting evidence base to facilitate decision-makers such as NICE.

References

1. Davenport T, Kalakota, R. The potential for artificial intelligence in healthcare. Future Healthc J. 2019; 6(2): 94-8
2. NICE. NICE publishes its first medtech briefing on artificial intelligence software [17th March 2020]. Available from: https://www.nice.org.uk/news/article/nice-publishes-its-first-medtech-briefing-on-artificial-intelligence-software
3. NICE. Artificial intelligence for analysing chest images [5th January 2021]. Available from: https://www.nice.org.uk/advice/mib243/resources/artificial-intelligence-for-analysing-chest-ct-images-pdf-2285965631267269
4. NICE. Butterfly iQ+ for diagnostic ultrasound imaging [4th March 2020]. Available from: https://www.nice.org.uk/advice/mib254/resources/butterfly-iq-for-diagnostic-ultrasound-imaging-pdf-2285965693413061
5. NICE. Lifelight First for monitoring vital signs [8th April 2020]. Available from: https://www.nice.org.uk/advice/mib213/resources/lifelight-first-for-monitoring-vital-signs-pdf-2285965449868741
6. NICE. RapidAI for analysing CT/MRI brain scans in people with suspected acute stroke [1st June 2021]. Available from: https://www.nice.org.uk/advice/mib262
7. NICE. Artificial intelligence in mammography [5th January 2021]. Available from: https://www.nice.org.uk/advice/mib242/resources/artificial-intelligence-in-mammography-pdf-2285965629587653
8. NICE. Artificial intelligence for analysing CT brain scans [17th March 2020]. Available from: https://www.nice.org.uk/advice/mib207/resources/artificial-intelligence-for-analysing-ct-brain-scans-pdf-2285965396121029
9. NICE. Immunoscore for predicting risk of colon cancer relapse [3rd August 2021]. Available from: https://www.nice.org.uk/advice/mib269/resources/immunoscore-for-predicting-risk-of-colon-cancer-relapse-pdf-2285965762277317
10. NICE. HealthVCF for detecting vertebral compression fractures on CT scans [13th July 2021]. Available from: https://www.nice.org.uk/advice/mib267/resources/healthvcf-for-detecting-vertebral-compression-fractures-on-ct-scans-pdf-2285965758918085
11. NICE. AI technologies for detecting diabetic retinopathy [6th July 2021]. Available from: https://www.nice.org.uk/advice/mib265/resources/ai-technologies-for-detecting-diabetic-retinopathy-pdf-2285965755558853

Contact: Daniella Foster, Market Access Research Scientist

Tel: +44 20 3432 7450 E-mail: daniella.foster@phmr.com

PHMR Ltd., Berkley Works, Berkley Grove, London, NW1 8XY