The Alan Turing Institute

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One in four UK doctors are using Artificial Intelligence

Exploring doctors' perspectives on AI after the emergence of large language models

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Abbreviations

The Alan Turing Institute (the Turing)

GMC: The General Medical Council

AI: Artificial intelligence

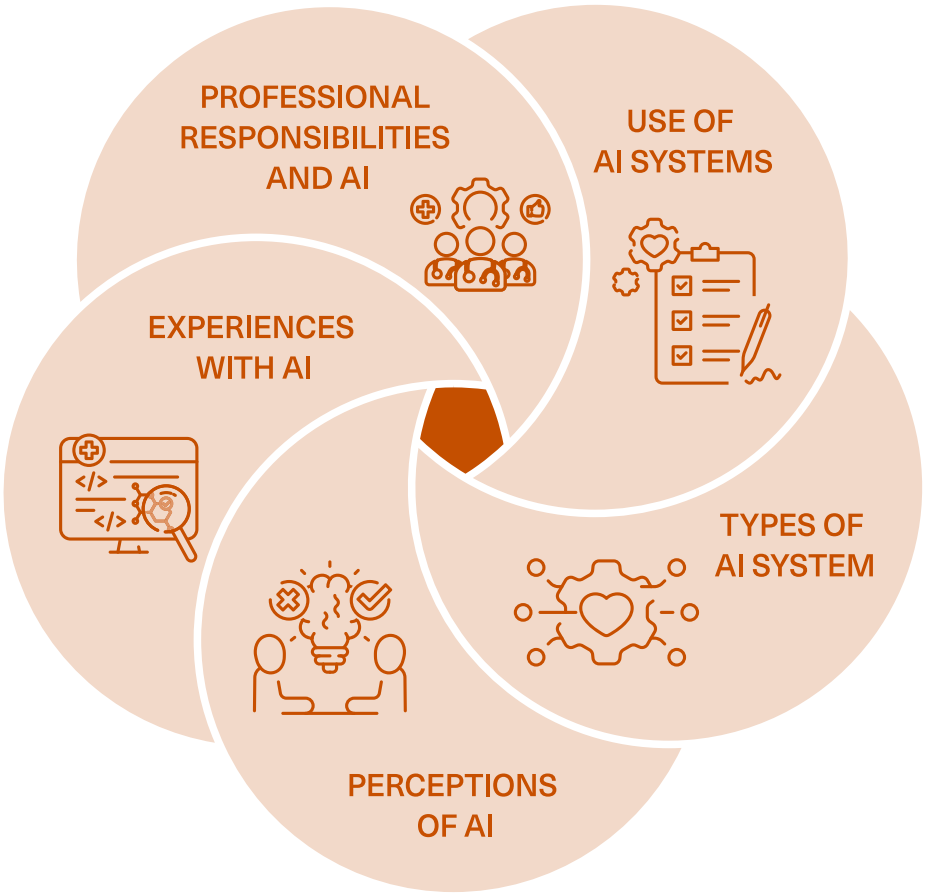
HEE: Higher Education England

DDS: Diagnostic and decision support

SES: System efficiency systems

Executive Summary

This report presents results from a project undertaken by The Alan Turing Institute (the Turing) with support from the General Medical Council (GMC) to explore UK doctors' experiences with, and perceptions of, artifical intelligence (AI) in their work. A survey on AI use was completed by 929 UK registered doctors between December 2023 and January 2024. The survey looked at the use of three types of AI systems: diagnostic and decision support (DDS) systems that are designed to help doctors diagnose patients or improve clinical decision making; efficiency focussed systems that aim to improve the allocation of medical resources or the functioning of clinical settings; and generative systems such as ChatGPT that can aid in the creation of text and images. The survey asked a range of questions about doctors' perceptions of both the potential and actual use of these types of AI system in their work.



Key findings diagram

Key findings

> Use of AI systems

AI is embedded in the working life of a sizeable portion of doctors, with 29% reporting that they had made use of at least one AI system in their work in the last year. Of those that had reported any AI use, more than half said they were using the system at least once a week. However, the majority of doctors are not making any use of AI systems in their work, meaning that there are significant areas where the potential of the technology isn't being explored.

> Types of AI system

In terms of the type of system used, 16% of doctors reported using DDS systems, with a further 16% using generative AI. Fewer doctors (7%) reported using systems focussed on efficiency.[1]

> Perceptions of AI

Doctors were generally positive about AI systems, with a majority (52%) saying they were optimistic about the technology's deployment in the healthcare system. Most doctors (54%) also felt opportunities for AI in healthcare were not being fully explored. Only a minority of doctors (15%) felt the technology was making them worried about their job security.

> Experiences with AI

Doctors' experiences of actually using AI systems were also positive. A majority (62%) of DDS system users felt that the systems improved their clinical decision making. A majority (62%) of generative AI system users felt that these systems improved their productivity. However, whilst most DDS users (56%) felt that they had received sufficient training on the system they were using, only a minority (15%) of generative AI users felt that the training they had received was sufficient.

> Professional responsibilities and AI

Doctors generally felt that they would be confident to ignore the recommendations of AI systems if they disagreed with them (54%). However, only 30% felt they had a clear understanding of who was responsible if an erroneous decision was made using an AI system, whilst only 12% felt they had sufficient training in order to enable them to understand their professional responsibilities when using AI systems (even amongst the group of doctors using AI, this number was only 17%).

In conclusion, AI is clearly an important part of the working life of many doctors, though most also feel that its adoption could go far further, and that the technology is currently underexploited. Those doctors that are using it are positive about its impact on their working life, with few worried about job security. However, concerns were raised in the area of training, with some doctors unclear about lines of responsibility if AI-supported decisions were made incorrectly.

[1] It is worth mentioning that respondents were able to choose more than one system to account for the use of different types of systems in their work.

Introduction

This report presents findings from a research project exploring doctors' perceptions and experiences of using AI systems in their professional work, and their understanding of their professional responsibilities in relation to the use of these systems. The research undertaken involved a survey of doctors practising in the UK, sampled from the UK medical register.

It has been widely recognised that AI has significant potential to enhance the provision of public services [6][7]. AI systems are beginning to be deployed across the public sector to support a wide variety of functions such as policy making, service delivery, and internal management [9]; and recent advances in generative AI (such as ChatGPT) are also potentially driving 'bottom up' engagement with systems by allowing public sector workers to integrate these tools into their workflows as they see fit [2], notably to support their own productivity [5].

Healthcare is one of the domains of public service with the highest amount of potential application areas for AI. In recent years, reports have highlighted its potential use in areas such as diagnostics, knowledge generation, public health, system efficiency, and predictive, personalised, and preventative medicine [14]. The potential application of generative AI is also increasingly of interest. Furthermore, though there is (to our knowledge) no comprehensive list of AI systems currently deployed in the NHS, there is considerable evidence that many AI systems are already in use. For example, the AI in Heath and Care Award website features data on AI Award trials, showing a wide range of potential use cases.[2] The AI Roadmap Dashboard[3] from Health Education England (HEE) also shows a similar number of application areas.

With the rollout of AI systems within UK healthcare, a number of studies have started to explore the perceptions of clinical end-users of AI systems. Many of these studies are relatively small-scale surveys or interview analyses; however, they do indicate a high degree of receptiveness across healthcare and clinical staff regarding AI technologies and their potential for reducing workloads. For example, a survey of AI perceptions amongst healthcare staff at one NHS Trust found that 79% of respondents believed that AI could be useful or extremely useful in their field of work, and only 10% were worried that AI would threaten their job security [3]. Research with doctors in training within the UK also found that the majority (58%) perceived an overall positive impact of AI technologies on their training and education [1]. Respondents agreed

[2] See the AI Award site map, maintained by the NHS Transformation Directorate: **https://tinyurl.com/ynbfe4pu**
[3] See the AI Roadmap here: **https://tinyurl.com/3j7r82tb**. It is worth noting that, at time of writing, the roadmap has not been updated since December 2022.

that AI would reduce clinical workload (62%) and improve research and audit training (68%). Meanwhile, a qualitative study conducted with both clinical and non-clinical NHS staff also identified a generally positive perception of AI use in healthcare settings, with participants expressing optimism around the potential for the technology to better facilitate patients' access to care [4]. Small scale empirical work has also been undertaken regarding perceptions of, and experiences with, artifical intelligence in the NHS in the area of workforce planning, with positive results [8].

Thus far, however, few studies have explored doctors' experiences of actually making use of AI, given the early stage of deployment of such systems in clinical settings. Our survey seeks to fill this gap. This work is especially important given the recent rapid development of generative AI, which has generated new pathways for deployment and adoption of these systems with significantly lower barriers to entry for use. This study therefore aims to address this gap through research with a representative sample of UK doctors to understand experiences of existing use, impacts, and perceptions of this new technology.

Methodology

The sample of doctors contacted for the survey was provided by the GMC. The GMC maintains the medical register, which is a list of doctors in the UK.[4] A random sample of approximately 30,000 doctors was drawn from the register by the GMC, who then contacted all those selected in the sample to provide them with an opportunity to be removed from the research. Following a small number of removals, a list of email addresses was then shared with researchers at the Turing, who distributed an invitation to participate in the research (with two further reminders sent to those who had not completed the survey). All participating doctors completed the survey between December 2023 and January 2024. The Alan Turing Institute's Ethics Advisory Group (EAG) granted ethical approval for the project.[5] No information on the survey respondents was shared with the GMC, and after the closure of the survey, the original list of email addresses was deleted.

Just under 929 doctors responded. A breakdown of the demographic profile of respondents, compared to the overall demographic profile of doctors on the GMC register, is available in **Appendix**. While broadly reflective of the population of doctors in the UK, respondents were slightly more likely to be male and slightly more likely to be in older age groups than the average profile of doctors on the UK medical register. To improve its representativeness, the sample was weighted by respondents' age, gender, where they obtained their primary medical qualification, and their registration status. All results reported in the document are weighted results, though we would note that there were no major differences between the weighted and unweighted results (all differences between weighted and unweighted results were four percentage points or less). Further information on the weighting procedure is available in **Appendix**.

In the survey, which took approximately 15 minutes to complete, doctors were asked a range of questions about their perceptions and experiences of AI systems. To ensure clarity in our survey and subsequent analysis, it was crucial to establish a working definition of AI systems for our respondents. This is challenging as there are numerous definitions and descriptions of AI drafted in varying forms of complexity and related to functions, capabilities, or human comparators [13]. Furthermore, AI as a technology has a wide (and constantly expanding) scope, with many current applications just a few years old. In our work, we followed a recent NHSx report that defined AI as "the science of making machines do things that would require intelligence if done by people" [14] . Building on this definition, and for the purposes of this work, we defined AI as *"automatic or computerised systems that are trying to emulate some type of human intelligence or support some kind of intelligent decision-making or thought process"*.

[4] For more information, see: **https://www.gmc-uk.org/registration-and-licensing/the-medical-register**
[5] Reference number 23111604

In the survey we aimed to capture a range of such systems that participants may have experienced or been familiar with to understand use and perceptions in more detail. Hence, in addition to presenting this general definition to respondents, we also provided them with three example areas in which AI systems could be used to automate or augment medical or care-related tasks. These three definitions were:

> **Diagnostic and Decision Support Systems:** Systems that directly support medical decision making by, for example, identifying medical conditions or predicting risk.

> **System Efficiency Systems:** Systems that try and optimise the internal workings of a healthcare service by, for example, predicting missed appointments or forecasting staff levels.

> **Generative Systems:** Systems such as ChatGPT that create text or images, that could be used, for example, to draft responses to patient queries.

The text summarising DDS systems and system efficiency systems was adapted to include a number of the areas of care which may be automated or augmented by AI systems, building on the NHSx report definitions used earlier [14]. To enhance clarity, we adapted the descriptions to include potential use cases. Additionally, we incorporated a definition of generative systems, reflecting their increasing use and prevalence [2].

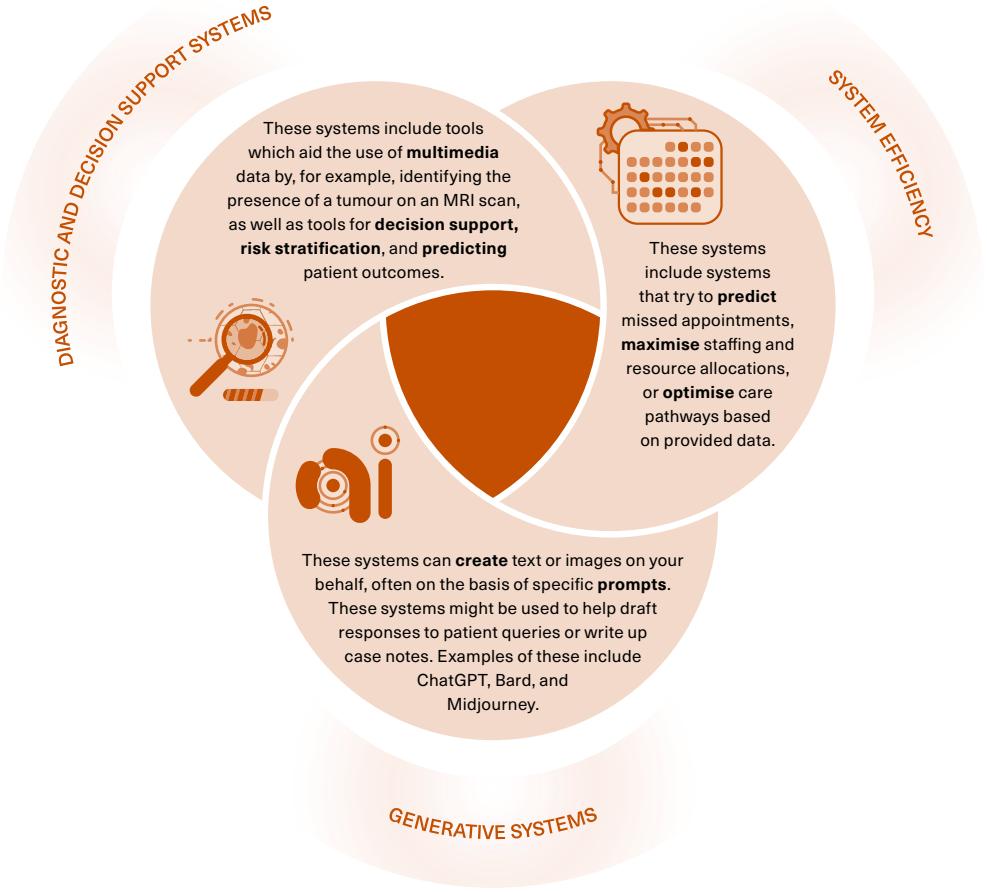


Figure 1: Image depicting the three types of AI systems that were presented to doctors.

Results

Use of AI systems

Variable	Value	Weighted %
Proportion of doctors who said they were using… (n = 929)	Any AI	29
	Diagnostic and decision support (DDS) systems	16
	Generative Systems	16
	System efficiency systems (SES) and any other system	7
Common application areas of DDS systems (n = 126)	Image processing	25
	Risk assessment and Triage	24
	Prognosis or Diagnosis	12
	Electrocardiogram (ECG) or Cardiotocography (CTG)	6
Common types of generative AI used (n = 113)	GPT	77
	Bard	6

Table 1: AI usage broken down by type: weighted results

We will now move on to presenting the results of the study, beginning with usage of AI systems. Overall, 29% of respondents said that they had used some form of AI system in their practice within the last 12 months. DDS systems (16%) and generative AI systems (16%) were the most prevalently used, with usage of systems focussed on efficiency or other types of systems lower at 7% (Table 1).[6]

Respondents were also asked the details of the AI system they make most frequent use of in a free text question. We analysed their answers and grouped them as shown in Table 1
For DDS systems, image processing and risk assessment were the most common examples of these types of AI systems (with 25% and 24% respectively). For generative AI, different versions of ChatGPT from OpenAI were by far the most commonly used tool (77%). It is worth noting that while some doctors are using multiple tools, they were only asked to name their most frequently used tool.

[6] As doctors could indicate that they are using more than one type of system, the percentages for each individual type of system sum to more than the overall percentage of doctors using AI.

	Period	All AI (%) (n = 270)	DDS (%) (n = 126)	Generative AI (%) (n = 113)
AI Use Frequency	Every day	26	38	8
	At least once a week	31	27	37
	At least once a month	16	15	18
	Less than once a month	15	7	25
	Don't know	13	13	13

Table 2: AI use frequency

Respondents were then asked how often they were using the AI system that they used most frequently. More than half of respondents (56%) reported that they use this AI system at least once per week, and 73% reported using it at least once per month (Table 2). We found that users of DDS systems report higher frequency of usage than generative AI users: 65% of users of DDS tools use them at least once a week, compared to 44% for generative AI systems (Table 2).

Value	Variable	Any AI (%)	Generative AI (%)	DSS (%)
Gender	Female	26	12	16
	Male	33	19	16
Age	Under 40	31	17	16
	40-49	32	15	17
	50+	24	13	14
Registration Status	GP	28	16	15
	LED and SAS	29	16	13
	Specialist	36	18	21
	Trainee	24	12	15

Table 3: AI use broken down by demographics and speciality

Value	Variable	Any AI (%)	Generative AI (%)	DSS (%)
Speciality or area of practice	Anaesthetics and Intensive Care Medicine	24	11	12
	Emergency Medicine	30	13	20
	General Practice	26	14	15
	Medicine[7]	37	20	19
	Paediatrics	27	19	11
	Psychiatry	11	8	0
	Radiology	48	11	40
	Surgery	34	20	16

Table 3: AI use broken down by demographics and speciality (cont.)

Looking at our findings on AI usage across the cohort of doctors as shown in Table 3, we can see that men and younger doctors are somewhat more likely to report using AI compared to women and older doctors (33% vs 26% for men vs women, 31% vs 24% for under 40 vs 50+). This is largely driven by higher usage of generative AI amongst male and younger doctors. Across specialities, doctors working in radiology and medicine were more likely to report using AI compared to other groups, with nearly half (48%) of radiologists using some type of AI in their work. At the other end of the scale, those working in psychiatry were the least likely to have reported using any AI system in the last 12 months (11%). However, we should note that not all medical specialities were well represented in our sample, so there may be some smaller specialities with particularly higher or lower usage rates that we do not capture.

Perceptions of AI

We will now move on to analysing doctors' perceptions of AI and their views on its likely impact on their work. This section presents the opinions of all surveyed doctors, while also comparing the perspectives of those already using AI in their practice with those who are not (AI users being those who said they have made use of at least one AI system in the last 12 months). Doctors were asked a range of questions about their perceptions in the form of statements. For each statement, they were presented with five possible responses: strongly agree, agree, neutral, disagree, and strongly disagree. In our results, we collapse the categories into agreement, neutral, and disagreement, for ease of analysis.

[7] This is an aggregate specialty group including general internal medicine, cardiology, rheumatology and other specialities.

Overall, the respondents had largely favourable perceptions of AI use in a professional context (Figure 2). Just over half (52%) agreed with the statement *"I am optimistic about the integration of AI systems in healthcare/clinical practice"*, a number that rose to 63% for those already making use of AI in their work. Indeed, most respondents also thought there was more that could be done with AI in the medical profession. Only 14% agreed with the statement *"Opportunities for AI in healthcare are being fully explored"*, with 54% disagreeing. Furthermore, most doctors thought the technology was mature enough for adoption: only 13% agreed with the statement *"AI is being deployed before it is ready in my area of practice"*, with 38% disagreeing.

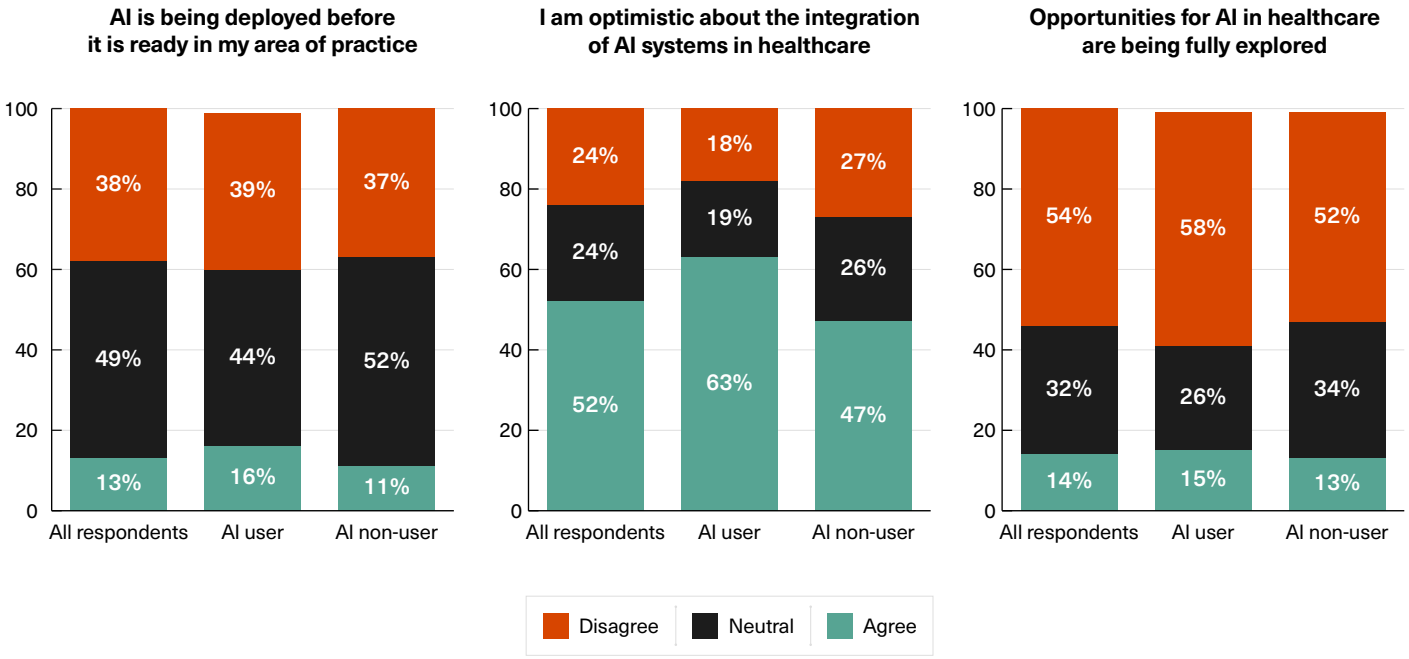


Figure 2: Doctors' perceptions of the opportunities of AI in healthcare

We also sought to elicit concerns doctors may have about the impact that AI might have on their careers (Figure 3). Again, responses were largely positive. Only 15% of doctors agreed with the statement *"Advances in AI are making me worried about my job security"*, with this figure being even lower at 11% for AI users. Slightly more doctors agreed with the statement *"Advances in AI are likely to limit training or learning opportunities"* (28%), though the number was still much lower than those who disagreed (51%).

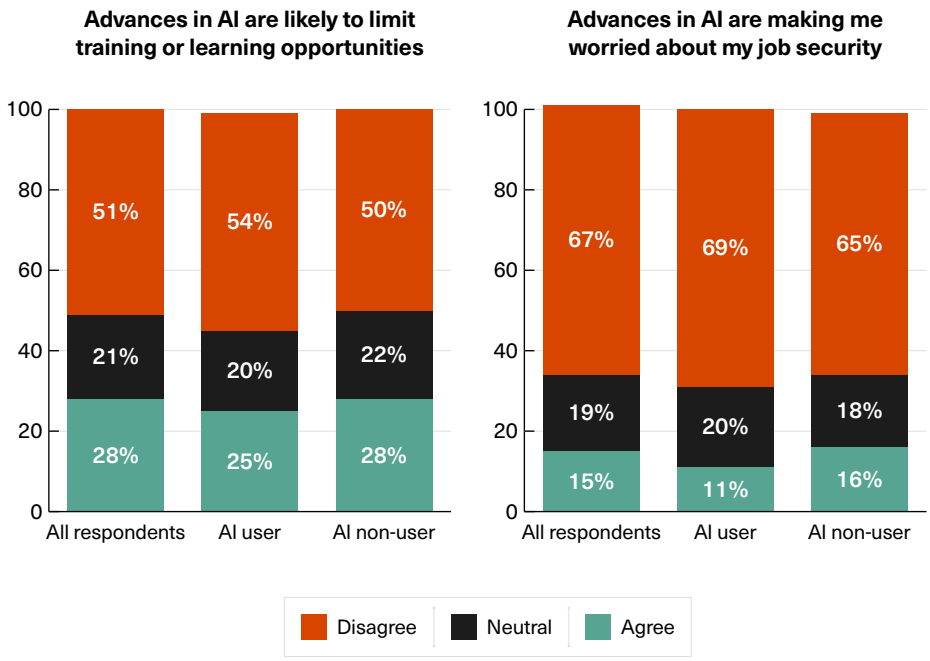


Figure 3: Doctors' perceptions of the impact of AI on their careers

In terms of demographic differences in these opinions, men were in general more positive across all questions: they tended to be more likely to say that opportunities for AI were underexplored, and were more likely to agree that it is ready to be deployed. Male respondents tended to report more understanding of risks and and were less concerned about AI limiting their job security and learning opportunities. A full breakdown of all results by demographics is available in the **Appendix**.

To summarise, there is considerable optimism for the technology across the medical profession, and agreement that it is both ready to be deployed and that opportunities related to its use are underexplored. Lastly, less than a fifth of respondents were worried about the negative impact of AI on their job security.

Experiences with AI

We asked a set of supplementary questions about the experiences of doctors who said they had made use of an AI system in the last 12 months. In this section, we only asked doctors to respond to questions based on the system that they were making use of most frequently. Hence, the results reported below reflect the views of 126 users of DDS systems, and 113 users of generative AI systems. There was insufficient data to report on experiences of using systems focussed on improving efficiency.[8] Continuing with our established approach, doctors responded to statements using a five-point scale that we later collapsed into agreement, neutral, and disagreement categories for analysis.

[8] Only 27 doctors selected a system focussed on efficiency as their most frequently used system.

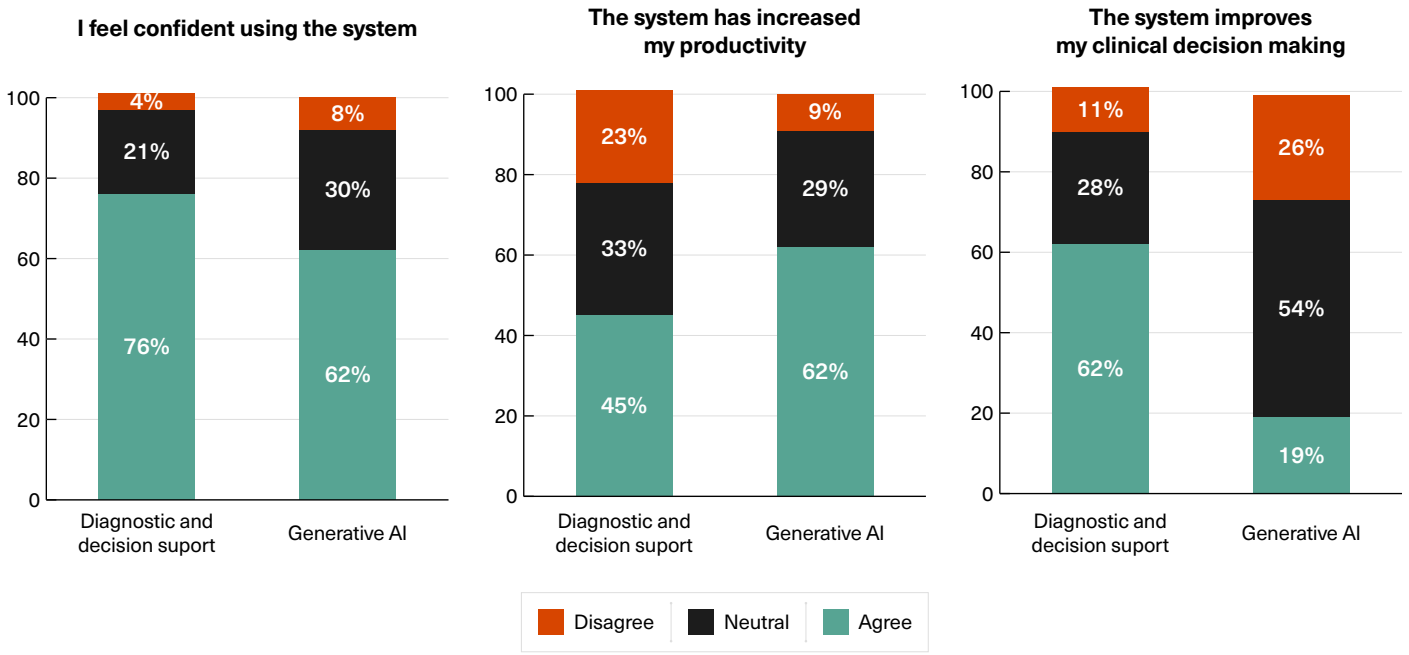


Figure 4: Impact of AI systems on doctors' working practices

Doctors were generally confident using these systems and positive about the impact they had on their working practices (Figure 4). For both types of systems, a majority of doctors agreed with the statement, 'I feel confident using the system' (DDS: 76%, generative AI: 62%), with only a small number disagreeing with this statement. Doctors also generally agreed with the statement, 'The system has increased my productivity', especially generative AI systems where 62% of doctors agreed compared to only 9% who disagreed (the results were slightly more mixed for DDS systems, with 45% agreeing that the system increased their productivity compared to 22% disagreeing). Furthermore, doctors were positive that DDS systems improved their clinical decision making, with 62% agreeing with the statement 'The system improves my clinical decision making', and 11% disagreeing. Only 19% agreed with the same statement for generative AI (compared to 27% disagreeing), though this may also indicate that generative AI is not being used for decision-making. However, it is worth noting that only a minority of doctors reported being consulted during the implementation of both DDS systems (24%) and generative AI systems (9%) (Figure 5).

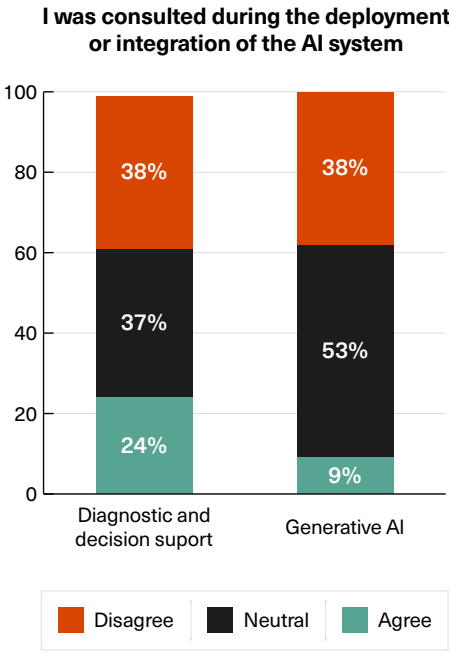


Figure 5: Doctors' experiences with being consulted on the deployment or integration of AI systems

We find that male respondents were more likely to report confidence in using AI, and more likely to feel it increases their productivity. Among speciality groups, surgeons and anaesthetists were comparatively less likely to agree that AI had enhanced their productivity. For further analysis of demographic differences, we refer the reader to the **Appendix**.

We asked another set of questions relating to understanding of AI systems (**Figure 6**). We first asked whether doctors found outputs of these systems clear and understandable, with large majorities agreeing (DDS: 80%, generative AI: 82%). We also asked if doctors felt they could explain the outputs of systems to patients. There were high levels of agreement for this question for DDS systems (70%, against just 8% who disagreed). The picture was more mixed for generative AI (34% agreeing against 16% disagreeing, with a large number of neutral responses). However, generative AI may be less likely to be directly used in medical decision-making so the need to explain its outputs to patients is arguably lower.

In addition to this, we asked if the doctors felt they had received sufficient training on the system. The respondents generally agreed with this statement for DDS systems (56%, against 17% disagreeing) but disagreed for generative AI systems (only 15% agreeing compared to 45% disagreeing). Finally, doctors were asked if they understood how to raise any concerns they had around the system. The results were mixed, with 44% of doctors agreeing for DDS systems, and 20% agreeing for generative AI systems.

In terms of demographic differences, men were more likely to say they understood how to raise concerns and that they could explain AI system outputs, while older doctors were less likely to agree that system outputs were clear and understandable. In addition, older doctors were more likely to report that they have had sufficient training for using AI systems, and that they were consulted during the deployment of these systems.

Overall, the experiences of doctors using AI systems appear to be positive: there is a high level of confidence using the systems, as well as a prevalent belief that AI improves both productivity and decision-making, with outputs perceived as clear to doctors themselves and explainable to patients. However, there were some concerns about levels of training, especially for generative AI, and a lack of awareness about pathways to raise concerns. Most doctors also did not feel consulted on the systems they were making use of prior to their deployment.

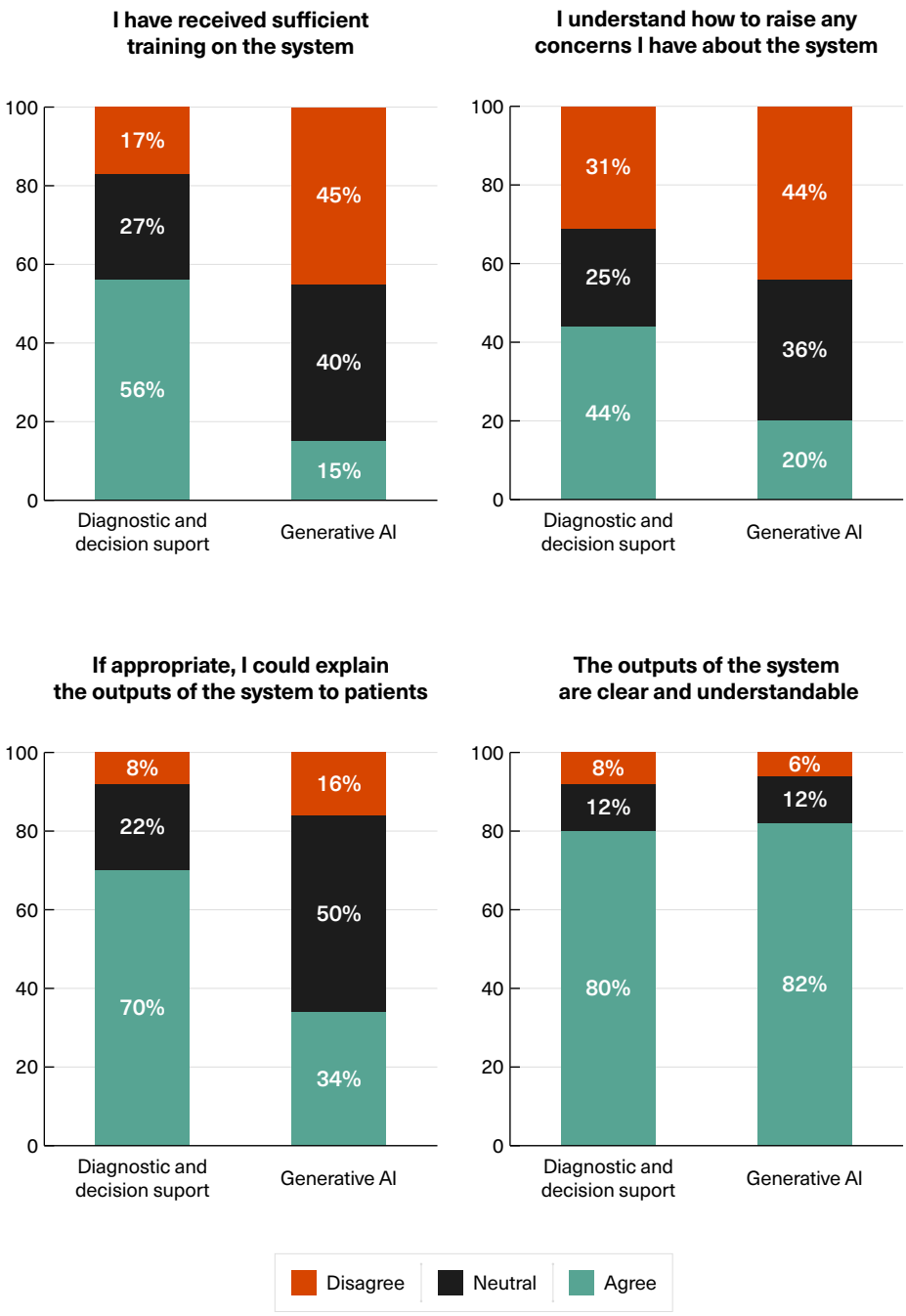


Figure 6: Doctors' understanding of of AI systems

Professional responsibilities and AI

In this section, we move on to exploring doctors' perceptions of professional responsibilities and AI. This section contains responses from all 929 doctors who completed the survey, as well as a breakdown into AI users and non-users.

We first asked doctors whether they agreed with the statement "*I understand the risks of AI in healthcare in my area of practice*". Agreement was moderate: amongst all doctors the figure was 44%, rising to 53% for AI users (Figure 7). We then asked them if they agreed with the statement "*I understand who is responsible if a decision is made incorrectly involving an AI system*". Only 30% of doctors agreed with this statement, though the number rose to 37% for AI users. Finally, we asked doctors about the training they have received in relation to their professional responsibilities. Only 12% of doctors agreed with the statement "*I have had sufficient training to understand my professional responsibilities when using AI systems*", with the figure at just 17% for doctors who report using AI (Figure 7).

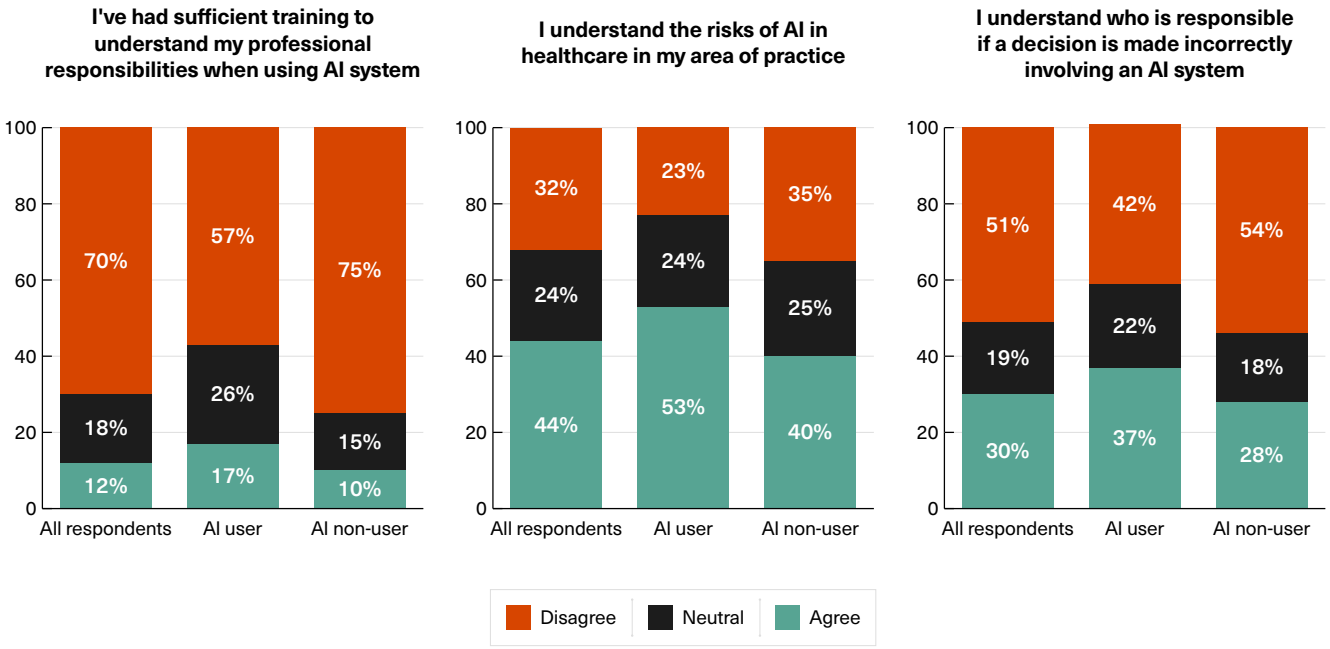


Figure 7: Doctors' understanding of responsibilities and risks of using AI

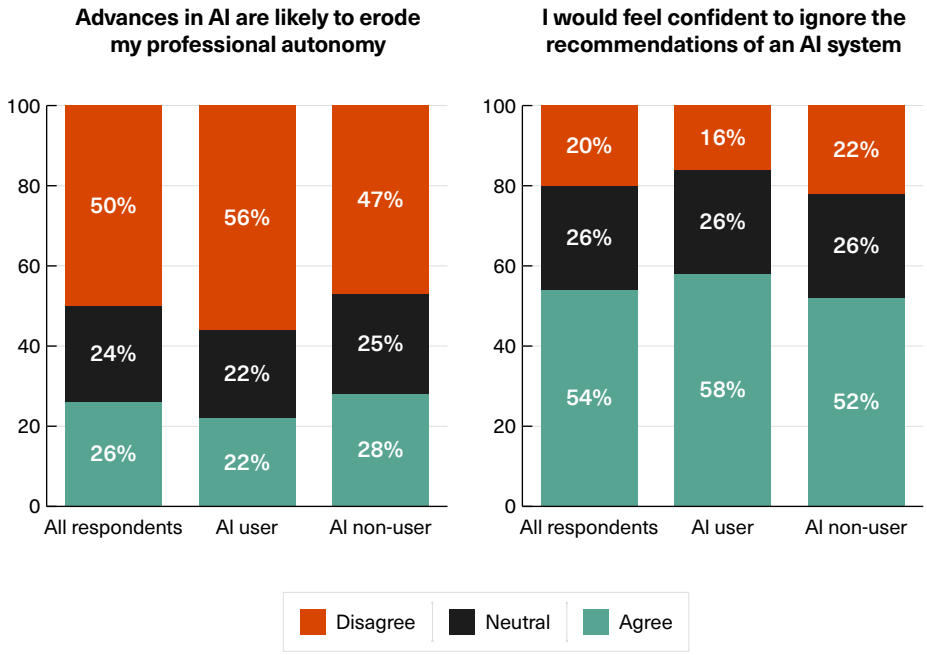


Figure 8: Doctors' perceptions of professional autonomy and responsibility when using AI

Guidance for doctors makes clear that they remain responsible for the decisions they make when using medical devices, including AI systems, to support their work. However, such guidance recognises not all doctors are involved in the creation, testing, and updating of these technologies. Those involved in these elements, whether they are developers, employers, or doctors, remain responsible for those aspects once they are in use.[9] We asked doctors two questions about this area (Figure 8). First, we asked them if they agreed with the statement "*Advances in AI are likely to erode my professional autonomy*". Only 26% agreed with this statement, whilst 50% disagreed. For AI users, even fewer doctors (22%) agreed with this statement. Then, we asked doctors if they would feel confident to "ignore" the recommendations of an AI system: i.e. if they would feel comfortable using their professional judgment to overrule such a system if they disagreed with the recommendation the system was making. Overall, 54% of doctors said they would, compared to just 20% who said they would not. The number agreeing with the statement was again slightly higher for actual users of AI systems (58%).

In terms of demographic differences in this section, men tended to report more understanding of the risks of integrating AI into healthcare, more confidence in ignoring the recommendation of AI systems, and were more likely to agree they understood who is responsible if a decision is made incorrectly involving an AI system. Men also reported

[9] For further information, see: **https://www.gmc-uk.org/professional-standards/learning-materials/artificial-intelligence-and-innovative-technologies**

less concern over AI limiting their professional autonomy compared to women. In addition, doctors who qualified in the UK were less likely to agree they understand the risks associated with AI in their practice and who is responsible when incorrect decisions are made involving AI. They were also less likely to agree that they have had sufficient training to understand their professional responsibilities when using AI (see the **Appendix** for further demographic breakdowns).

To summarise this section, there appears to be some uncertainty amongst doctors about both the risks presented by AI, and how responsibility for incorrect decisions made by AI should be handled, with a particular feeling that current levels of training were insufficient to help them understand this. Despite this, few doctors were worried about AI eroding their professional autonomy and most felt that they would be confident overriding a decision made using AI if they needed to.

To explore these issues further, we asked doctors how they would respond to the following scenario: *"You are using an AI clinical decision-support system which recommends treatment options for individual patients. You disagree with the recommendation that is given by the system. How would you proceed?"*. In total 821 doctors (88%) responded to this question, with the remaining 12% stating that they "don't know" how they would proceed. We conducted a thematic coding exercise on these free-text responses, with one of the report's authors reading the full set of responses and grouping them into themes. Their work was checked by two other authors who independently worked through a subset of questions, with any issues resolved through discussion.

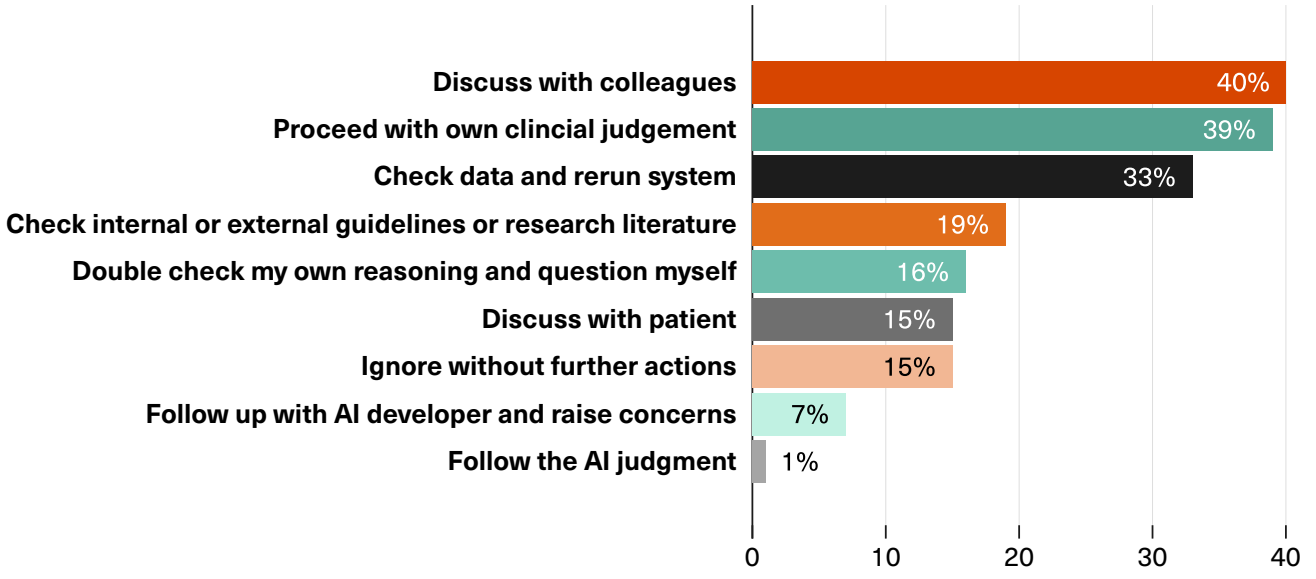


Figure 9: Key themes emerging from doctors' responses (n=821)

The main themes which emerged in the free-text responses are shown in Figure 9, presented as percentages of all doctors who gave a free-text response to the question (note that as some of the responses mentioned more than one theme, the total percentages sum to more than 100). In their responses, doctors raised a variety of different potential pathways for action. The most common response was to discuss the result of the AI systems with colleagues (40%), perhaps discussing with a senior consultant or raising it at a multi-disciplinary team meeting. Such recurring team meetings are common in the NHS, where healthcare professionals of different specialities discuss patient care, especially for complex cases. The second most frequently mentioned scenario (39%) was the doctor proceeding with their own clinical judgment rather than that of the AI system. However, we should note that this option was infrequently mentioned in isolation (15%), with doctors usually anticipating they would take some other steps beforehand rather than simply ignoring the system completely. Many respondents (33%) also suggested checking input data and rerunning the AI system to check for errors.

Analysis of internal or external guidelines, or research literature, was also mentioned (19%), as was simply double checking their own assumptions (16%) and discussing the results with the patient themselves (15%) if appropriate. Interestingly only 7% suggested any kind of contact with the developers of the AI system. Finally, very few doctors suggested that they would simply follow the judgment of the AI (1%). It is also worth highlighting that several respondents also mentioned that the scenario presented may also incur additional work and time for doctors in checking their own reasoning and may present anxiety regarding a potential later issue.

Overall, these results show that doctors would generally be sceptical of a situation where the output of an AI system conflicted with their own judgment, and would seek a number of alternative pathways to gather more information and explain the differences of opinions before taking further action. When further action is taken, doctors' responses demonstrate that there would be a large bias towards following their own professional judgment rather than the AI system itself.

Discussion

Our findings illustrate that AI is embedded in the working life of a substantial minority of doctors in the UK: over a quarter (29%) of the surveyed doctors reported using AI at least once in the last 12 months prior to completing the survey, with DDS and - despite their relative nascence - generative AI systems being used the most frequently. However, the majority of doctors are not making any use of AI, meaning that there are significant areas in the profession where the potential of the technology isn't being fully explored. These findings align with previous research where 24.3% of respondents working in the NHS reported using some form of AI [2]. For doctors making use of the technology, the frequency of use was also striking: when asked about their most frequently used system, more than half of the doctors reported using it at least once a week, and 70% at least once per month.

Doctors who reported using AI were largely positive about their experiences, with the majority reporting high levels of confidence using these systems, as well as a clarity of understanding in the outputs generated. There appears to be general optimism around the use of AI systems in clinical practice, with few doctors believing that these systems are being deployed before they are ready. These results broadly align with prior survey research undertaken with doctors in Portugal [10], in which 76% of respondents agreed that AI would revolutionise medicine and 73% agreed that it will improve it.

Although doctors are largely positive about the adoption of AI technologies, professional autonomy and responsibility remain areas of vital concern when AI is deployed in high-stakes sectors like health and social care. In a recent widescale survey by The Health Foundation, members of the public reported concerns over the impacts they perceive AI might have on clinical decision-making, namely the role these systems may play in eroding health care staff's decision-making autonomy and their ability to question outputs of AI systems [11]. Here, our results demonstrate that most UK doctors do not share these concerns: the majority of doctors feel they are able to retain autonomy over their decision-making when AI is being used to support their work, and that they are able to approach AI outputs that counter their own decisions with a necessary degree of scepticism. More than half of doctors using AI indicated they would feel confident to go against the recommendations of an AI system, and a similar number disagreed with the statement that AI is likely to erode their professional autonomy. Doctors were also able to identify a number of pathways to seek further information and reassurance if they disagreed with the recommendations of an AI system.

The same survey by The Health Foundation also revealed concerns around the potential impact AI integration may have on the human dimension of healthcare delivery. Interestingly, these findings echo similar findings from a study of patients' perspectives on AI carried

out in 2019 [12], highlighting an area of concern that has persisted over the past few years of AI development and deployment. Although our survey did not explicitly seek to elicit doctors' opinions on the impact AI may have on this aspect, we did explore the question of job replacement and found that the majority of doctors were not concerned that AI would threaten their job security. Future research which explores doctors' perspectives on the automation of interactive tasks would be greatly valuable and would facilitate a cross comparison of patient' and doctors' perspectives, experiences, and concerns.

Our findings also highlight the importance of delineating the different types and uses of AI systems, acknowledging that the term AI encompasses a wide class of technologies with various capabilities and applications. This is demonstrated by a few notable differences identified in doctors' experiences with the use of DDS systems versus generative AI systems, such as the stark differences reported in agreement that these systems improve clinical decision-making. Doctors using DDS systems reported significantly higher levels of agreement that these systems improve their decision-making compared with doctors using generative AI systems. Conversely, doctors were more likely to report that generative AI systems increased their productivity compared with DDS systems. Whilst perhaps unsurprising given the intended uses of both of these systems, these findings underscore the importance of clearly identifying the type of AI system being referenced in exploratory research such as this. Viewing all AI systems in aggregate risks masking key differences which could offer valuable insights.

It is of course important to highlight some of the limitations of this study. While we endeavoured to draw as representative a sample of UK doctors as possible, we were ultimately unable to control which doctors would respond to the survey. While our weighting was designed to address demographic biases, there may be other sources of bias it is unable to address: for example, doctors who are more interested in AI and technology may have been more likely to take the survey. A number of specialities were also not represented in the final sample. Future work that addressed these gaps, for example focussing on the experiences of specific specialities, would be highly valuable. Further to this, many of the questions in this survey sought to explore opinions and experiences, and therefore necessitate a level of self-reporting and subjectivity. For example, we have no way of validating whether doctors truly understand the risks of AI use. Further work in this area would also be valuable. Indeed, the GMC, who supported this study, have commissioned follow-up qualitative research in this area, which is expected to be published in early 2025.

We hope this research can serve as a launchpad for further streams of research that are looking to map the usage and perceptions of AI amongst professionals across domains. More specifically, we hope these findings can be used to facilitate comparative studies across different countries and contexts. The use of AI within health and social care necessitates a rich and robust evidence base to inform its adoption, and to help guide emerging policy and regulatory instruments.

Appendix

A1: Demographics and weighting

Table A1 shows characteristics of respondents in our sample versus the total population of doctors on the UK medical register as of June 2024. For gender, age, registration status, PMQ, and speciality, the frequency of the sample was aligned with the UK medical register after missing value imputation and weighting.

Value	Category	Frequency sample (%) (n = 929)	Frequency UK medical register %
Gender (n-register=315,771)	Female	39	50
	Male	60	50
	Others	1	0
Age (n-register=315,771)	Under 30	10	15
	30-39	30	35
	40-49	24	25
	50-59	23	17
	60 years and over	13	9
	NA	1	0
Registration Status (n-register=325,555)	GP	19	21
	LED and SAS	24	29
	Specialist	34	28
	Trainee	21	22
	NA	4	0
PMQ (n-register=315,771)	EEA	12	8
	IMG	33	34
	UK	56	58

Table A1: Demographics of our sample of doctors versus demographics of all doctors on the UK medical register. Source: **GMC website , June 2024**

Any missing values for four categories of gender, age, registration status, and PMQ were imputed using KNN method[10] (k = 5) to align with the GMC categories and to prepare the dataset for weighing (4% NAs in registration status group, 1.5% in gender[11], 1% in age and no missing values in PMQ). Since the GMC doesn't hold data on area of practice (speciality) for every doctor, we didn't weight for this, and hence we didn't impute missing values for this variable.

The demographic data in Table A1 shows that women and younger doctors are slightly under-represented, while specialists are overrepresented in our survey. Hence, we weighted our sample to align with that of UK medical register to ensure the results are representative. We considered the four categories of gender, age, registration status and PMQ and used raking weighting which iteratively assigns weights to observations in the sample until the distribution of variables in the sample is the same as the distribution of the population.[12]

A2: Demographic breakdowns by question

Group	Sub group	Choice	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18
Registration Status	GP	Agree	10	14	39	17	33	23	55	66	31	8	77	86	47	51	54	25	38	57
		Disagree	37	49	38	67	44	55	23	16	52	77	8	7	29	19	20	38	34	8
		Neutral	53	37	23	16	23	22	22	18	17	15	15	7	24	30	26	37	28	35
	LED and SAS	Agree	16	16	48	16	28	37	47	42	35	15	75	79	32	38	58	14	37	49
		Disagree	32	52	25	57	43	44	22	29	46	62	4	4	30	11	3	33	37	16
		Neutral	52	32	27	27	29	19	31	29	19	23	21	17	38	51	39	53	26	35
	Specialist	Agree	15	12	40	10	20	23	56	60	28	14	72	86	48	45	49	25	40	59
		Disagree	44	59	32	78	59	55	25	17	51	72	6	9	24	15	22	35	28	11
		Neutral	41	29	28	12	21	22	19	23	21	14	22	5	28	40	29	40	32	30
	Trainee	Agree	8	14	48	17	26	25	49	50	29	8	62	71	18	30	54	3	22	44
		Disagree	39	54	33	64	51	51	27	18	54	70	2	6	38	28	19	46	47	13
		Neutral	53	32	19	19	23	24	24	32	17	22	36	23	44	42	27	51	31	43

Table A2: Questions grouped by demographics

[10] The KNN algorithm looks for the 'k' nearest neighbours of the data point with missing values based on the distance metric calculated from the available features. The missing value is imputed by aggregating the corresponding values of those 'k' neighbours. For numerical data, this could be the mean or median of the neighbours' values. For categorical data, it could be the most frequent category among the neighbours.

[11] While we had defined other genders apart from male/female in our survey, there was no other gender group definined in the UK medical register. Hence, we had to impute other categories of gender in our dataset to align with the UK medical register and to do the weighting. However, it was just 1% in our sample and didn't affect the results.

[12] It is worth noting that as some doctors might be registered under more than one category on the medical register (e.g. Trainee and GP), the sum of all registration status for the population of doctors on the register exceeds the sum of all doctors (325,555 > 315,771). In that regard, the percentages for registration status of the UK medical register in the table are relative to the sum of all registration status groups. We did this since the percentages should have sum up to 100 for weighting.

Group	Sub group	Choice	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18
Age	40-49	Agree	14	14	40	15	24	27	57	52	26	12	62	82	39	39	50	19	32	55
		Disagree	38	53	31	70	53	54	22	20	53	73	10	9	30	17	22	31	34	14
		Neutral	48	33	29	15	23	19	21	28	21	15	28	9	31	44	28	50	34	31
	50+	Agree	16	12	40	11	27	23	53	58	31	15	79	78	59	50	50	29	50	67
		Disagree	37	47	32	71	51	52	24	18	49	68	5	11	18	18	23	34	22	6
		Neutral	47	41	28	18	22	25	23	24	20	17	16	11	23	32	27	37	28	27
	Under 40	Agree	11	15	48	16	27	30	49	53	32	10	74	82	29	40	56	13	31	47
		Disagree	38	58	31	63	47	49	25	21	50	69	3	4	33	17	10	41	41	13
		Neutral	51	27	21	21	26	21	26	26	18	21	23	14	38	43	34	46	28	40
Speciality	Anaesthetics and Intensive Care Medicine	Agree	15	6	27	13	25	21	41	54	32	8	60	77	39	43	40	15	31	52
		Disagree	38	56	46	73	61	60	27	21	51	79	40	4	41	28	31	41	23	16
		Neutral	47	38	27	14	14	19	32	25	17	13	0	19	20	29	29	44	46	32
	Emergency Medicine	Agree	18	13	51	18	34	46	40	38	26	12	80	100	57	39	61	15	39	55
		Disagree	38	51	24	55	42	27	32	33	53	70	5	0	9	27	11	41	39	30
		Neutral	44	36	25	27	24	27	28	29	21	18	15	0	34	34	28	44	22	15
	General Practice	Agree	9	15	43	17	28	22	56	64	33	9	72	84	46	51	58	26	37	57
		Disagree	37	49	38	67	49	58	22	18	48	73	8	7	28	16	17	35	36	6
		Neutral	54	36	19	16	23	20	22	18	19	18	20	9	26	33	25	39	27	37
	Medicine	Agree	10	13	42	14	25	29	45	53	27	15	72	75	33	43	46	15	32	44
		Disagree	39	53	28	65	47	47	26	17	55	62	4	7	31	14	15	34	42	10
		Neutral	51	34	30	21	28	24	29	30	18	23	24	18	36	43	39	51	26	46
	Paediatrics	Agree	15	13	36	14	30	30	56	40	31	13	54	76	38	27	71	51	18	30
		Disagree	47	60	30	72	45	50	24	33	49	71	30	14	47	17	17	49	50	46
		Neutral	38	27	34	14	25	20	20	27	20	16	16	10	15	56	12	0	32	24
	Psychiatry	Agree	4	16	50	11	23	25	53	59	22	7	50	76	21	27	44	21	21	44
		Disagree	36	50	35	75	62	54	30	17	64	73	8	24	39	73	24	39	35	16
		Neutral	60	34	15	14	15	21	17	24	14	20	42	0	40	0	32	40	44	40
	Radiology	Agree	10	23	50	11	19	22	82	58	26	11	76	85	41	23	52	23	46	76
		Disagree	54	58	24	59	64	60	10	16	51	60	4	7	25	25	20	55	48	16
		Neutral	36	19	26	30	17	18	8	26	23	29	20	8	34	52	28	22	6	8
	Surgery	Agree	22	16	47	11	24	32	57	50	31	12	71	79	25	43	48	16	34	57
		Disagree	37	63	32	74	50	51	21	21	51	79	3	7	28	12	13	40	33	4
		Neutral	41	21	21	15	26	17	22	29	18	9	26	14	47	45	39	44	33	39
PMQ	EEA	Agree	17	12	55	15	22	22	56	55	37	25	80	93	35	44	65	16	41	67
		Disagree	33	53	23	62	55	51	20	18	42	61	6	4	32	23	7	51	30	17
		Neutral	50	35	22	23	23	27	24	27	21	14	14	3	33	33	28	33	29	16
	IMG	Agree	16	18	49	16	24	34	54	42	41	16	73	78	33	50	70	13	33	47
		Disagree	31	53	19	59	46	47	16	26	33	57	3	4	32	11	4	32	38	12
		Neutral	53	29	32	25	30	19	30	32	26	27	24	18	35	39	26	55	29	41
	UK	Agree	10	11	39	14	28	25	50	60	23	8	70	82	42	35	39	22	37	56
		Disagree	43	55	40	72	51	53	29	18	62	78	7	9	26	21	26	39	34	11
		Neutral	47	34	21	14	21	22	21	22	15	14	23	9	32	44	35	39	29	33
Gender	Female	Agree	12	14	38	15	27	28	43	47	25	10	67	82	39	41	44	17	34	48
		Disagree	33	51	35	64	44	48	26	23	56	72	5	4	28	14	19	42	43	12
		Neutral	55	35	27	21	29	24	31	30	19	18	28	14	33	45	37	41	23	40
	Male	Agree	13	14	50	15	25	28	61	61	35	13	76	81	37	42	61	18	36	57
		Disagree	43	57	28	69	55	54	22	18	46	68	6	8	29	20	13	34	30	12
		Neutral	44	29	22	16	20	18	17	21	19	19	18	11	34	38	26	48	34	31

Table A2: Questions grouped by demographics (cont.)

Table A2 shows a breakdown of responses to each question across the main demographic variables in our survey. Each question is a column in the dataset, with rows representing the values for “Agree”, “Disagree”, and “Neutral” responses. The question referred to in each column is shown in Table A3 below.

Label	Question Text
Q1	AI is being deployed before it is ready in my area of practice
Q2	Opportunities for AI in healthcare are being fully explored
Q3	I understand the risks of AI in healthcare in my area of practice
Q4	Advances in AI are making me worried about my job security
Q5	Advances in AI are likely to erode my professional autonomy
Q6	Advances in AI are likely to limit training or learning opportunities
Q7	How optimistic or pessimistic are you about the integration of AI systems in healthcare/ clinical practice
Q8	I would feel confident to ignore the recommendations of an AI system within my area of practice
Q9	I understand who is responsible if a decision is made incorrectly involving an AI system
Q10	I have had sufficient training to understand my professional responsibilities when using AI systems
Q11	I feel confident using the system
Q12	The outputs of the system are clear and understandable
Q13	I have received sufficient training on the system
Q14	The system improves my clinical decision making
Q15	The system has increased my productivity
Q16	I was consulted during the deployment or integration of the AI system
Q17	I understand how to raise any concerns I have about the system
Q18	If appropriate, I could explain the outputs of the system to patients

Table A3: Glossary

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