

Artificial intelligence in healthcare : A comprehensive survey of healthcare professionals in India

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Abstract

Objective: Artificial intelligence (AI) is widely recognized as a transformative force that is expected to significantly influence patient care in the near future. This study aims to evaluate the level of awareness regarding AI technologies among healthcare professionals in India, as well as to explore their perceptions of AI's potential applications in medical practice.

Design: An online survey using Google Forms was administered to healthcare professionals employed at prominent hospitals in Delhi, India.

Setting: Invitations to complete the online questionnaire were sent via email exclusively to staff employed at major hospitals with a capacity of over 500 beds.

Participants: A total of 264 healthcare professionals participated in the survey, comprising 80 medical doctors, 54 nurses, 46 pharmacists, 34 physiotherapists, and 50 individuals from other healthcare professions.

Primary outcome: The study aims to explore healthcare professionals' prior knowledge of AI, along with their attitudes and concerns regarding its present and future applications.

Results: In the 'knowledgebase' section of the survey, 56 respondents (42%) indicated that they had not experienced any use of AI applications in their professional practice. Furthermore, it was shown that 75% of the participants lacked awareness regarding the distinctions between machine learning and deep learning, despite the fact that 83%

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demonstrated familiarity with at least one of these terminologies. Furthermore, a mere 9% of respondents indicated that they employ speech recognition or transcription software in their professional settings on a daily basis, while a significant 37% claimed never utilising such tools. A significant proportion of healthcare professionals polled (117, 89%) voiced apprehensions over significant privacy risks associated with AI, with 43% suggesting that AI may pose a greater threat than nuclear weapons. However, a significant proportion of participants (84, 63%) regarded AI as beneficial or highly beneficial in their respective fields, although 32% voiced apprehensions regarding the possibility of AI supplanting their positions in the professional environment.

Conclusion: Although there is consensus regarding the utility of AI in the medical domain, a significant number of healthcare practitioners possess an incomplete comprehension of the fundamental principles of AI and express concerns regarding the potential ramifications of its extensive implementation in clinical settings. This study aims to provide a comprehensive analysis of the awareness and perception of healthcare professionals in India regarding the integration of AI in the healthcare industry. The importance of this study resides in its capacity to provide crucial observations that can provide valuable guidance to policymakers, healthcare organisations, and AI developers regarding the dominant attitudes and viewpoints across the healthcare workforce in India.

Subject Classification: *Primary 68T01, Secondary 62P10, 91D30.*

Keywords: *Artificial intelligence in healthcare, Healthcare professionals' perceptions, AI applications in medicine, Privacy and ethical concerns, AI awareness and adoption.*

Introduction

Artificial Intelligence (AI) refers to the ability of machines to replicate intelligent human behaviors, including learning from experience, adapting to new information, and executing tasks that generally require human cognition intelligence [1]. These processes include learning, which involves acquiring information and formulating rules for its application; reasoning, which involves applying those rules to reach approximate or definite conclusions; and self-correction. AI is a multifaceted scientific field that encompasses various methodologies and strategies. [2]These include machine learning, of which reinforcement learning and deep learning are particular examples; machine reasoning, which comprises search and optimisation; natural language processing, speech recognition; image processing; robotics, which encompasses control, perception, and actuators and integration of all other techniques into cyber-physical systems [3].

The rapid advancement of AI has led to its widespread exploration across various industries, with healthcare being a particularly promising domain. [4], [5], [6] The potential of AI to revolutionise healthcare lies in its capacity to analyse vast quantities of data and detect patterns, resulting

in enhanced precision in diagnoses, tailored therapies, and improved patient outcomes[7], [4]. AI applications in healthcare span various domains, one of which is the analysis of medical imaging [8], disease diagnosis and prediction [9] drug discovery and development[10] and personalized medicine [11]. AI also offers opportunities to improve efficiency, accuracy, and accessibility of care [12], [13], [14] In India, a country with a vast and diverse healthcare landscape, the integration of AI holds immense potential to enhance patient care, improve efficiency, and alleviate the burden on healthcare professionals (HCPs). These applications hold immense potential to improve healthcare delivery by:

Improving diagnostic precision and effectiveness: Artificial intelligence algorithms have the capability to analyse extensive quantities of medical data, facilitating earlier and more precise diagnoses, ultimately resulting in enhanced patient outcomes [15], [16], [17]

Enhancing resource allocation: Artificial intelligence has the potential to streamline administrative duties and procedures, so allowing healthcare professionals (HCPs) to allocate more time towards patient interaction and the delivery of treatment [18].

Advancing personalised medicine: Artificial intelligence (AI) has the capability to analyse comprehensive patient data and medical history, enabling the prediction of health risks, provision of preventive measures, and customisation of treatment plans to enhance patient-specific care [19] [20].

Contrary to the optimistic outlook, some researchers have identified skepticism and apprehension among healthcare professionals regarding the widespread adoption of AI in healthcare. Some of them are ethical challenges regarding data privacy, data transparency, the declining doctor-patient relationship, accountability of data governance and potential disparities in AI deployment [21], [22]. The absence of a legislative framework that clearly defines liability in cases where physicians accept or reject algorithm suggestions exposes them to potential legal repercussions when utilising AI exacerbates the problem [23]. A study by [24] found that a significant proportion of healthcare professionals expressed concerns about the potential for AI to replace human jobs and compromise the quality of patient care. Therefore, a comprehensive comprehension of healthcare professionals' knowledge, attitudes, and worries about artificial intelligence (AI) is vital due to the apprehensions surrounding data protection, ethical implications, and the potential displacement of their jobs [25]. These findings highlight the significance of rectifying misconceptions and cultivating a more comprehensive comprehension of

AI's function as a supplementary instrument rather than a replacement for human expertise. A growing body of research has explored the perspectives of HCPs towards AI in various countries [26], [27]. These studies highlight a generally positive outlook towards AI, with HCPs recognizing its potential to improve healthcare delivery. However, concerns regarding ethical issues, data security, and potential job displacement have also been identified [28], [29].

It is important to acknowledge that the existing literature primarily originates from developed nations. The unique context of India, including its diverse population, resource limitations, low doctor-to-patient ratio, inadequately trained personnel, a disproportionate distribution of expertise, high costs, and delayed detection and diagnostic errors [30], [31], [32] require a dedicated investigation into the perspectives of Indian HCPs. Furthermore, the healthcare sector in India is undergoing significant changes driven by advancements in AI. According to the World Economic Forum, AI expenditure in India is expected to hit 11.78 billion by 2025, contributing \$1 trillion to the economy by 2035. Moreover, NITI Aayog's National Strategy for Artificial Intelligence research found a dearth of skilled healthcare practitioners and unequal healthcare access in India. The research says India has 64 doctors per 1,000,000 people, compared to 150 globally. Though regular AI deployment in healthcare is still new, current improvements can lead to a bright future [33]. This study aims to address this critical gap by providing a comprehensive survey of HCPs in India, exploring their knowledge and attitudes towards AI in healthcare.

Materials and Methods:

We used an online questionnaire adapted from [34] to assess the prior knowledge and perspectives on AI of a range of health professionals at top five hospitals in Delhi, India (hospitals with more than 500 beds). Research consistently shows that larger hospitals are more likely to adopt new technologies [35], [36]. Research also indicates that major hospitals are increasingly adopting AI technologies to enhance patient care and operational efficiency [37]. Through this comprehensive survey, we aim to elucidate the existing disparities among healthcare professionals regarding their knowledge and attitudes towards AI and its implications for the future of healthcare delivery in India.

Participants:

An electronic questionnaire to assess perspectives on AI in healthcare was developed using the open-source platform Google Forms. Healthcare professional from chosen hospitals received the survey via email with a unique URL. The survey was voluntary, and participants were told of the objective in the questionnaire's preface. Every response was given in an anonymous manner, ensuring that participants could not be identified based on the information provided. The collection of responses occurred solely upon the activation of the "submit" button located at the end of the questionnaire. Each participant was limited to submitting only one entry. The act of clicking the "submit" button indicated the provision of informed consent. The study does not include individuals classified as vulnerable and presents minimal risks of informational or psychological harm. Consequently, the participation of an Ethical Review Board was determined to be unnecessary [38].

Survey

This study follows the principles set forth in the Checklist for Reporting Results of Internet E-Surveys (CHERRIES), which is detailed in Table 1[39]. The survey comprises a partially classified inquiry regarding the profession of each participant (Q1), as well as seven closed-ended questions designed to evaluate the prior knowledge (Q2-4), attitudes, and concerns of healthcare professionals regarding the present and future applications of artificial intelligence (Q5-8). In November 2023, Rishi Sunak, the Prime Minister of the United Kingdom, delivered a public speech at the "AI Safety Summit" held at Bletchley Park in London. In the presence of prominent figures such as Elon Musk, U.S. Vice President Kamala Harris, and other individuals, Mr. Sunak expressed his apprehensions on the potential risks associated with the breakthroughs in artificial intelligence (AI). Question Q5 refers to this public speech. He argued that AI might potentially pose a significant threat to humanity, comparable in magnitude to pandemics and nuclear warfare. In question Q7, the term "useful" is employed without more elaboration for two distinct rationales:

Our main objective was to gather insights from healthcare professionals about the current and potential applications of artificial intelligence. Those who are not previously acquainted with AI might have unrealistic notions about its use in medicine, yet their expectations

regarding its future application may remain either optimistic or pessimistic. Additionally, the term 'useful' has been used similarly in prior research, such as in Oh's study on the views of Korean physicians toward AI [40].

Statistical Analysis

The acquired results were assessed utilising fundamental statistical techniques, including the calculation of totals and percentages. The researchers performed a subgroup analysis utilising the Kruskal-Wallis test, which was subsequently followed by a post-hoc analysis. This study aims to investigate the disparities in knowledge and attitudes among different healthcare professionals, including but not limited to doctors, nurses, chemists, physiotherapists, and other related occupations. This study employed the Statistical Package for the Social Sciences to conduct the tests. A p-value of ≥ 0.05 was used to determine the level of significance for all tests.

Results

The survey involved a total of 264 healthcare workers, comprising 80 medical physicians, 54 nurses, 46 chemists, 34 physiotherapists, and 50 individuals from various other healthcare professions. The distribution of survey participants across different professions is detailed in Table 2. In the "knowledgebase" component of the survey, a total of 56 respondents (42%) reported that they had not encountered any instances of AI applications in their professional roles. Furthermore, it was shown that 75% of the participants lacked awareness regarding the distinctions between machine learning and deep learning, despite the fact that 83% demonstrated familiarity with at least one of these terminologies. Moreover, only 9% of respondents indicated that they use speech recognition or transcription software daily in their professional environments, while 37% reported never utilizing these tools. Figure 1 illustrates the participants' knowledge regarding artificial intelligence and its applications in professional settings. A large number of healthcare professionals surveyed (117, 89%) expressed concerns about serious privacy issues related to AI, with 43% indicating that AI might be more dangerous than nuclear weapons. However, a significant proportion of participants (84, 63%) regarded AI as beneficial or highly beneficial in their respective fields, although 32% voiced apprehensions regarding the possibility of AI replacing their positions in the professional environment.

Participants' attitudes and concerns regarding artificial intelligence are visualized in Figure 2.

Table No. 3 shows the findings of a subgroup analysis that only found statistically significant differences per profession for only two questions (Q3 and Q4). As a result, Kruskal-Wallis test was used with the Bonferroni adjustment to account for multiple testing in post-hoc analysis of Q3 and Q4 (Table No. 4). A statistically significant difference was seen between medical doctors and individuals in all other professions (Nurse, Pharmacist, Physiotherapist and other HCPs), as indicated by the post-hoc analysis conducted on Q3. Approximately 77% of medical doctors reported being familiar with both terms and understanding the distinction between them, however none of other professionals responded with the same answer.

Nevertheless, a post-hoc analysis of question Q4 indicates a statistically significant difference between the professions of 'medical doctors' and 'other healthcare professionals.' Among the 40 medical doctors surveyed, 11 reported regular use of voice recognition or transcription applications. Conversely, none of the other healthcare professionals (other HCPs) acknowledged using such applications.

Discussion

The survey's findings suggest the vast majority of individuals aren't well-versed in AI or even aware of its potential applications. 21% of respondents used at least one AI-based application on the job and 42% never used any at all. Only 25% of people who took the survey understood the difference between deep learning and machine learning, whereas almost one-third had no understanding of what either of these words meant. Despite the widespread use of AI applications in everyday clinical practice (such as automated ECG interpretation, electronic health records, and electronic prescription), 42% of participants said they had never encountered AI in their job. This could be due to a lack of education about AI and some confusion about what exactly entails AI. Moreover, 80% of respondents indicated that they rarely or never utilised speech recognition and transcription applications in the workplace, despite the fact that these tools are extensively employed in daily life like Alexa, Siri, etc.[41]. This could indicate a common reluctance to change that is often seen in healthcare [42] and may stem from uncertainty about accountability in case of errors caused by an AI tool, particularly when there is limited comprehension of the AI tool's behaviour.[43], [44].

According to the study, 63% of participants hold the belief that AI might be beneficial in the field of medicine, which is consistent with previous studies conducted by [40] and [45]. Nevertheless, a significant majority of 89% of participants voice apprehensions over privacy risks associated with the widespread implementation of AI in the healthcare sector, whilst 83% concur with Rishi Sunak's assertions that "There is a case to believe that AI may pose a risk on a scale like Pandemics and nuclear war" [46]. It is important to acknowledge, however, that an only 35% of medical practitioners agreed with this statement. Consistent with findings from previous research on artificial intelligence (AI), a higher proportion of respondents (58%) conveyed a moderate to high degree of concern regarding the potential displacement of their present occupation by AI. Case in point: research by [47] found a strong link between AI and increased rate of job displacement. The country may experience significant unemployment as a result of the rapid progress in machine learning, robotics, and other AI-related technology [48]. According to research by [49] over 48% of all technology experts think robots might one day carry out the majority of routine, automated tasks. Nearly half of the 700 jobs identified by [50] might be superseded within the next 20 years, according to their model.

There is a dearth of material on how the public views medical AI. Researchers looked at how people generally feel about using AI in healthcare in a research published in [51]. The public's perception of AI in healthcare is shifting towards a more sceptical stance, in contrast to the optimistic portrayals in mainstream media. The degree of confidence is contingent upon the medical domain under examination, demographic attributes (e.g., Western background, higher education, male gender), and the overall positivity towards AI and its efficacy in everyday life. These factors are notably correlated with greater levels of confidence in AI applications within the medical field. An additional investigation [52] was undertaken to examine attitudes and expectations regarding medical artificial intelligence in the field of stroke. The majority of participants were optimistic about medical AI and its ability to improve the quality, timeliness, and efficiency of medical decision-making; however, they did warn that AI is not a panacea and might potentially cause more issues. In particular, participants voiced concerns about the potential effects of AI on patients' rights to knowledge and decision-making, as well as the significance of relational factors. These results illuminate the possible effects of AI in healthcare on professional identities, views of roles, and the doctor-patient dynamic.

Conclusion

The healthcare industry in India needs more education and knowledge for healthcare professionals on artificial intelligence (AI) and its possible uses, as well as the pros and cons of these technologies. Despite the growing recognition of AI's ability to greatly enhance patient care, the integration of AI applications into medicine has lagged behind the rapid advancements in technology[53]. Potentially due to apprehensions regarding accountability and responsibility in the event of errors, healthcare professionals are at least partially resistant to adopting these technologies, which contributes to this discord. Additionally, it is critical to cultivate trust and acceptance of AI in healthcare by addressing concerns regarding job displacement, privacy, and safety. As a matter of fact,[54] explores the possibilities of artificial intelligence in enhancing healthcare accessibility, quality, and cost-effectiveness while also acknowledging the necessity of a long-term regulatory structure. So, to make the most of AI-based technologies and their promise to improve healthcare delivery and outcomes, we need to find approaches to get individuals to accept change while employing them. Due to the intricate nature of the subject, further investigation and research are necessary. This includes researching specific factors that influence variations in knowledge and attitudes among healthcare professionals, exploring how education and training programmes can enhance AI literacy and decrease apprehension, and conducting research on the ethical and legal consequences of AI integration in the healthcare industry. By overcoming these issues, we can facilitate the appropriate and efficient incorporation of AI into the Indian healthcare system, eventually benefiting both patients and healthcare professionals.

In summary, the objective of this research article is to present a thorough examination of the knowledge and attitudes held by healthcare professionals in India on the integration of artificial intelligence (AI) in the healthcare sector. The importance of this study resides in its capacity to provide crucial observations that can provide valuable guidance to policymakers, healthcare organisations, and AI developers regarding the dominant attitudes and viewpoints across the healthcare workforce in India.

Limitation

Our study lays the groundwork for emerging nations like India to incorporate AI into their curricula. It is important to mention that our

study had several limitations. We must recognise many limitations in our investigation. The sample size of 264 participants was insufficient to detect statistically significant variations in replies among occupations, with the exception of questions Q3 and Q4. In these questions, doctors demonstrated the most knowledge of basic AI terminologies and reported using AI applications more frequently in their daily work compared to other healthcare professionals. Furthermore, the sample consisted solely of the top hospitals in Delhi. Utilising a convenience sample may have notable limits regarding its capacity to be generalised to the population. The survey was deliberately designed to be brief and easy to understand to enhance participation in the research. No financial incentives were provided, and the questionnaire was disseminated online rather than in person, so limiting the response rate. Secondly, there was an absence of data about the participants' age and other demographic attributes, which may have emphasised disparities across groups. Additionally, there may be selection bias present, since respondents who participated in the study could have had a higher level of interest in AI and could have shown more favourable opinions compared to those who did not participate. An additional restriction is that the surveys were distributed randomly to healthcare providers. The participants may not have been a true cross-section of healthcare workers, but the research did encompass a range of healthcare professions and backgrounds. This method fails to account for the distinct views and attitudes of individual segments. It would be intriguing to analyse the distinctions among the groups separately. Subsequent research might include management-level positions and smaller hospitals. Furthermore, experimental investigations can yield more authentic and thorough outcomes.

Table 1

Online questionnaire on the perceptions of AI within health professionals. The survey was divided into three sections: Profession, knowledgebase, and Attitudes.

	Questions	Answers	Codes
Profession	Q1. What is your profession?	Medical Doctor Nurse Pharmacist Physiotherapist Other Healthcare Professional (Other HCP)	Q1

Knowledgebase	Q2. How many AI applications have you come across at work?	None One Two to four More than four	K1
	Q3. Are you aware of the distinctions between deep learning and machine learning?	Not at all I only know one term I know both terms but the difference is not clear to me I know both terms and the difference is clear to me	K2
	Q4. How frequently do you use speech recognition or transcription applications?	Never Rarely Weekly On a daily basis	K3
Attitudes	Q5. Do you think that using AI could raise significant privacy concerns?	Completely agree Partially agree Partially disagree Completely disagree	A1
	Q6. How much do you agree with the following statement: "There is a case to believe that AI may pose a risk to humanity on the scale of pandemics and nuclear war." (Rishi Sunak, 2023)	Completely agree Partially agree Partially disagree Completely disagree	A2
	Q7. To what extent do you believe AI could be useful in your field of expertise?	Extremely useful Useful Of limited use Of no use at all	A3
	Q8. To what extent are you worried about the potential replacement of your employment by AI?	Extremely worried Moderately worried Mildly worried Not worried at all	A4

AI, artificial intelligence.

Table 2
Various professions of survey participants

Profession	Number of respondents
Medical doctor	80
Nurse	54
Pharmacist	46
Physiotherapist	34
Other Healthcare Professional	50
Total	264

Table 3
Subgroup analysis according to participants' profession

Question	p-value ^a
Q2. How many AI applications have you come across at work?	0.063
Q3. Are you aware of the distinctions between deep learning and machine learning?	0.000
Q4. How frequently do you use speech recognition or transcription applications?	0.005
Q5. Do you think that using AI could raise significant privacy concerns?	0.054
Q6. How much do you agree with the following statement: "There is a case to believe that AI may pose a risk to humanity on the scale of pandemics and nuclear war." (Rishi Sunak, 2023)	0.177
Q7. To what extent do you believe AI could be useful in your field of expertise?	0.060
Q8. To what extent are you worried about the potential replacement of your employment by AI?	0.070

AI, artificial intelligence.

^ap-values were calculated using Kruskal-Wallis test.

Table 4
Post-hoc analysis for questions Q3-4 according to participants’ profession.

Question	p-value ^a	Post-hoc ^b
Q3. Are you aware of the distinctions between deep learning and machine learning?	0.000	Significant difference between “medical doctor” and “all other healthcare professionals” (nurses, pharmacists, physiotherapists and other HCPs)
Q4. How frequently do you use speech recognition or transcription applications?	0.005	Significant difference between “medical doctor” and “other healthcare professionals”

^a p-values were calculated using Kruskal-Wallis test.
^b Post-hoc analysis was conducted using pairwise Kruskal-Wallis tests with Bonferroni correction.

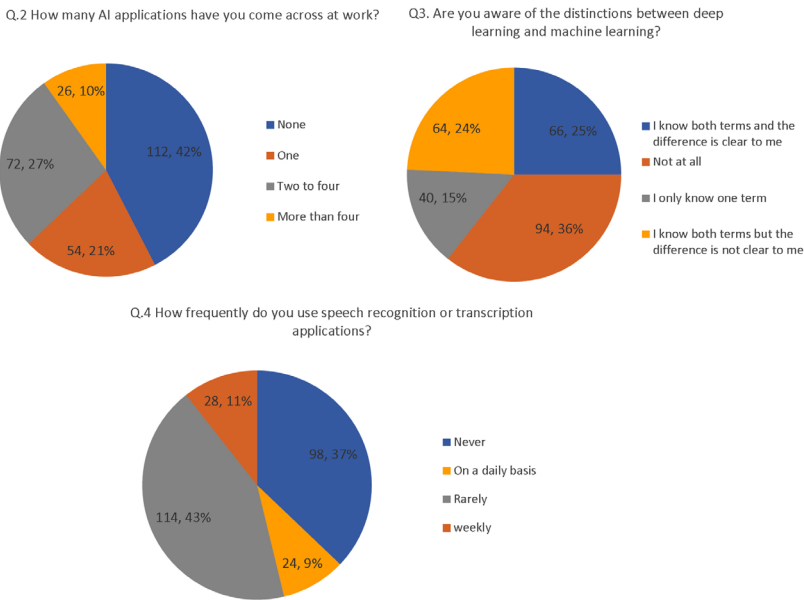


Figure 1
Participants’ knowledgebase regarding artificial intelligence (AI) and its applications.

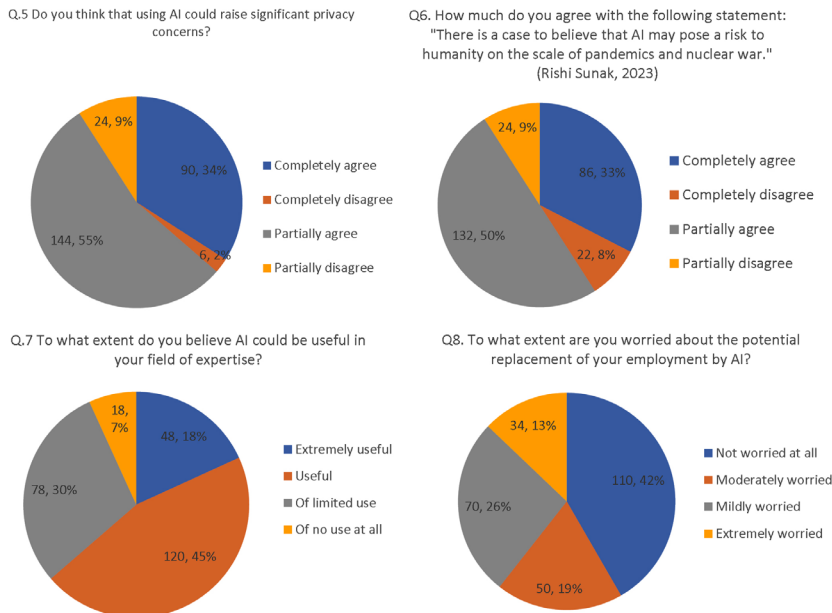


Figure 2

Participants' attitudes and worries regarding artificial intelligence (AI) and its applications

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