

**AWARENESS, KNOWLEDGE AND PERCEPTION TOWARDS
ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
AMONG MEDICAL STUDENTS AND HEALTHCARE
PROFESSIONALS: A CROSS-SECTIONAL STUDY**

Dissertation Submitted to



The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Avani Anand Garde

Under the Supervision and Guidance of

Dr. Susmit Jain

2022

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DECLARATION BY STUDENT

I hereby declare that this dissertation titled Awareness, Knowledge and Perception Towards Artificial Intelligence and Machine Learning in Healthcare Among Medical Students and Healthcare Professionals: A Cross-Sectional Study is the bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Avani Anand Garde

Date : 01/07/2022

CERTIFICATE

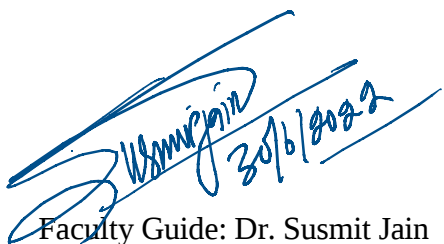
This is to certify that **Avani Anand Garde** in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur has successfully completed her/his internship at Meta16 Labs during March 22, 2022, to June 19, 2022.

Place: Bengaluru
Date: 29/06/2022

Preceptor/Head of the Organization: Mr. Anil JJ
Name of the organization: Meta 16 Labs Healthcare &
Analytics Private Limited

CERTIFICATE

This is to certify that dissertation titled Awareness, Knowledge and Perception Towards Artificial Intelligence and Machine Learning in Healthcare Among Medical Students and Healthcare Professional: A Cross-Sectional Study is a record of the research work undertaken by Avani Anand Garde in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.



Faculty Guide: Dr. Susmit Jain
IIHMR University, Jaipur

Date: 30/06/2022

School Dean: Dr. (Col.) Mahender Kumar
IIHMR University, Jaipur

Date

Awareness, Knowledge and Perception Towards Artificial Intelligence and Machine Learning Among Medical Students & Healthcare Professionals : A Cross-Sectional Observational Study.

Abstract

Background: Artificial Intelligence has been in use in almost all industries and is now gaining popularity in the healthcare world owing to its potential to revolutionize patient care, diagnosis and treatment. Tech-savvy younger generation, increase in awareness and fitness-oriented population are some of the many reasons for growth in uptake of AI-based smart medical devices such as smart wearables and fitness trackers. Apart from smart wearables, AI has its applications in many other fields of medicine like precision medicine, robotic surgeries, drug development and disease surveillance etc. But knowledge of AI and awareness levels among medical students and Practising healthcare professionals in developing countries like India is below expected levels as observed in previous studies and thus this study has been conducted to determine basic knowledge, awareness and perception regarding AI, ML and deep learning in healthcare among medical students and healthcare professionals in Nagpur City.

Objectives: To assess the knowledge, awareness and perception of medical students and healthcare professionals about AI/ML in healthcare in Nagpur City.

Materials and Methods: A cross-sectional study was conducted by circulating an online survey designed using Google Forms, which included demographic details and a set of 10 questions pertaining to the knowledge and perception about AI in healthcare. A total sample size of 200 (medical students and healthcare professionals) was taken and period of data collection lasted for one month. Data was analysed in MS Excel.

Results: More than half of the medical students and healthcare professionals in Nagpur city were fairly aware of artificial intelligence in healthcare and some of its applications which suggests that medical students and professionals are not in complete dark about these technologies. 80% have a basic understanding of common terminologies used in AI/ML and at least 65% are aware about some applications of AI in the field of medicine.

Key Words: Artificial Intelligence, Machine Learning, Healthcare, Perception, Attitude, Awareness, Knowledge, Medical Students, Doctors.

ACKNOWLEDGEMENTS

The completion of my dissertation project involves inputs, efforts, participation and assistance from many people, for which I am sincerely grateful and would like to express my deep appreciation for all those who have motivated and encouraged me from beginning till end.

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Special thanks to my friends and family for their constant encouragement in the times when I needed them.

Sincerely,

Avani Anand Garde

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ABBREVIATIONS

AI	Artificial Intelligence
ML	Machine Learning
DL	Deep Learning
NLP	Natural Language Processing
MBBS	Bachelor of Medicine, Bachelor of Surgery
BDS	Bachelor of Dental Surgery
BPT	Bachelor of Physiotherapy
B.Sc.	Bachelor of Nursing
HMIS	Hospital Management Information Systems
HOS	Hospital Operating Software
IT	Information Technology
HER	Electronic Health Records
EMR	Electronic Medical Records
CME	Continuing Medical Education

CHAPTER – ONE

INTRODUCTION

Artificial Intelligence can be defined as a branch of computer science concerned with developing smart machines that are capable of performing activities that typically entail human intelligence.^[1] While Machine Learning is a type of artificial intelligence that provides the computers the capability to learn and predict future outcomes without being explicitly programmed to do. Artificial intelligence algorithms are a collection, or a set of rules devised for learning from the responses or inputs based on which outputs are generated just as a neuron network in the human brain, this is called artificial neural network. Both Artificial Intelligence and Machine Learning in Healthcare are upcoming fields and has drawn attention worldwide due to its potential to revolutionize patient care and assist healthcare professionals in clinical decision as well as administrative functions in hospitals.^[1]

As India has a weak healthcare infrastructure, there are many limitations to AI and implementation of AI/ML in hospitals possess many barriers. Acceptance and awareness among the medical students and healthcare staff is one of the most leading reasons for low penetration rate and utilisation of AI/ML in healthcare in India. While on the other hand, increase in digitalization of medical records and the accuracy rates of AI shows great potential in the future of healthcare. AI in healthcare has various applicability – from automating monitoring patient vitals to patient scheduling, better diagnosis and management.^[2] This study is intended to investigate the awareness, knowledge and perception towards AI/ML in healthcare and also to study the awareness levels among medical students and healthcare staff and their willingness to accept future trends in AL in healthcare.

1.1 History of Artificial Intelligence in Medicine

In 1950s, Alan Turing came up with the idea of machine's ability to learn and think. The 1970s saw the uptake of AI in the field of medicine to solve biomedical problems but many limitations prevented worldwide acceptance and application. MYCIN was the first AI based system developed to predict the potential bacterial infection and recommend antibiotic treatment as per patient's weight. DXplain, was the first clinical decision support software developed by University of Massachusetts, to give information on approximately 500 diseases. IBM, a giant technology company, in 2007

invented a question answering software which was easier to use and maintain, used a technology called DeepQA, to analyse the patient's health information in Electronic Medical Records (EMR) to come up with evidence-based treatment options.

Natural Language Processing technology used in chatbots was applied to the most commonly used virtual assistants, namely Apple's Siri and Amazon's Alexa in the year 2011 and 2014. Several other chatbots have been developed in healthcare space like Pharmabot (2015) and Mandy (2017) for assisting pediatric patients and their guardians in medication and automated patient intake system for primary care practice respectively.^[10]

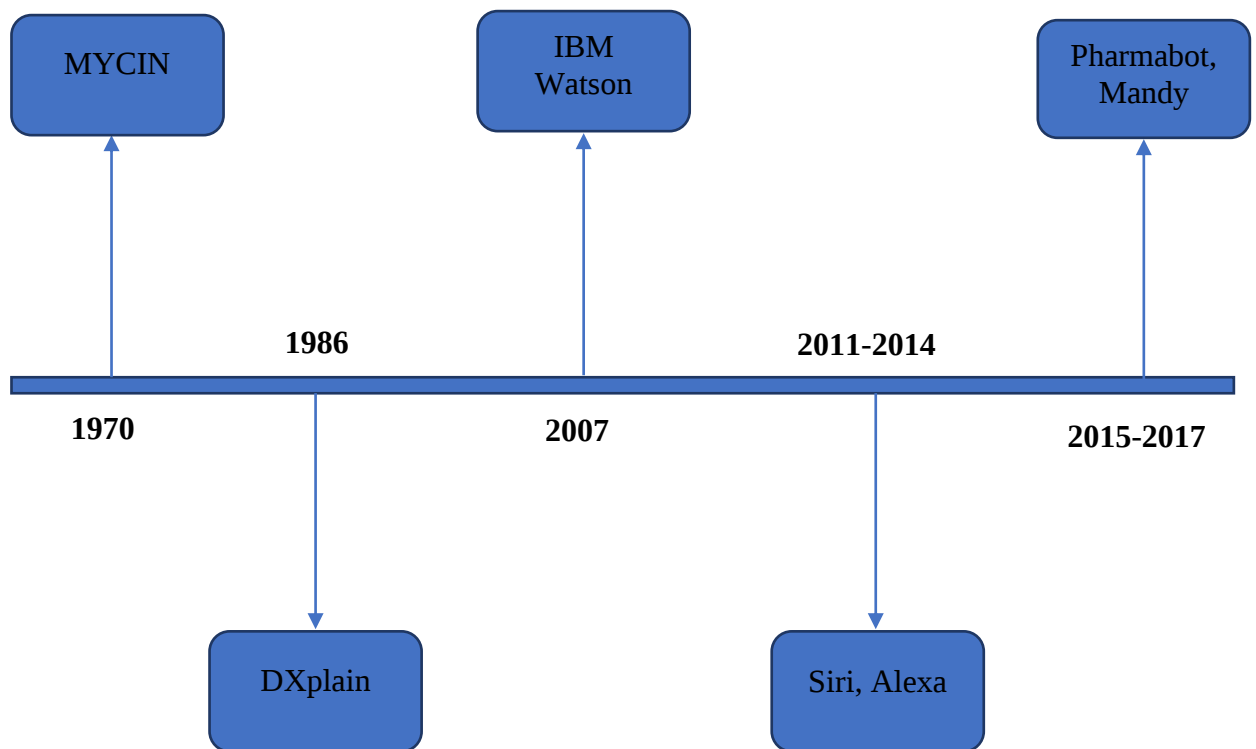


Figure 1 : History of AI in Medicine

Source : Timeline of development of AI in Medicine, (History of AI in medicine, author- Vivek Kaul et al.)

1.2 Applications of AI/ML

The applications of AI in healthcare can be broadly classified under the following heads: Automatic Preliminary Diagnosis and Treatment, Virtual Nursing Assistance, Precision Medicine, Surgery, Workflow and Administrative functions, Drug development and Clinical Trials, Remote Patient Monitoring, Consultations and Population Health.^[11]

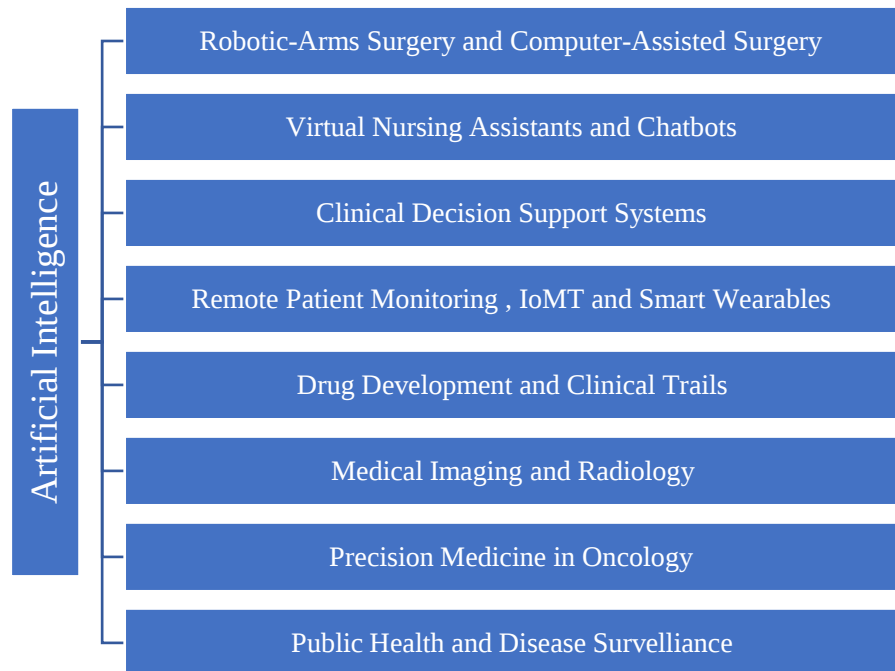


Figure 2 : Applications of AI/ML in Healthcare

1. **Clinical Decision Support Systems** – AI augments physicians in clinical decision making based on predictive analytics and machine learning algorithms. It helps in accurate and early diagnosis of conditions that can prove to be lifesaving if treatment is obtained in early phases. Medication Error Reduction systems use AI capabilities to minimize injuries and even deaths caused by medication errors. Medication errors like dosage errors, mode of delivery errors leads to wasting resources, physician's time and healthcare expenditure. Use of medication management software can prove to significant cost reduction and

highly efficient patient care. Non-adherence is another major factor contributing to increasing healthcare costs. AI-based mobile applications can confirm the ingestion of medicines in patients requiring long-term care.

2. **Chatbot Assistance and Virtual Personal Assistance (VPA)** – Incorporation of chatbots in hospital websites and appointment booking applications can help in triage and enhancing primary care to patients who do not require in-person consultation. AI based chatbots can process and store huge amount of data through previous encounters and medical records and make decisions which is data driven and evidence base.
3. **Robotic Surgeries** – AI powered robotic arms can perform minimally-invasive surgeries without the limitation of fatigue. Robotic and Computer Assisted Surgeries can reduce the chances of post-operative complications which means speedy recovery and patients can get back to their daily lives faster.
4. **Remote monitoring and virtual nursing assistance** – AI powered remote monitoring devices can measure and record vitals parameters of patients at the comfort of their homes and can detect even minute abnormalities in the health condition of patients and inform their healthcare providers to get instant virtual nursing assistance without wasting any time.
5. **Natural- Language Processing** – Voice recognition, text-to-speech, and use of NLP tools aids in routine tasks of the physicians such as prescriptions refill, scheduling appointment, making medical notes etc, saving hours of their time which they can utilise in care giving and clinical activities. With the advent of Artificial Neural Networks (ANN), and NLP, it is now possible to transform the traditional conversational system to intelligent chatbot assistance that is capable of mimicking human conversations.
6. **Drug Development** – AI capabilities have been utilized in clinical trials for development of new drug candidates. It aids in recruiting participants for clinical trial based on analysis of their history and medical records who are eligible for trials, during an ongoing trial, AI can be used to remotely monitor vitals and their health status, immediately send across alerts to investigators in case of an allergic or adverse drug reaction so that proper help and treatment can be given without wasting time. AI is also utilized in accurate endpoint assessment in oncology trials.

7. **Disease Surveillance** - AI and Machine Learning algorithms have been applied to public health data sets in order to detect patterns of disease spread, any anomaly in spatiotemporal status to assess the risk of an epidemic and alert public health officials of an outbreak.
8. **Medical Imaging** – Traditionally, interpretation of medical images and scans was done by highly skilled and trained radiologists requiring years of expertise, but in the recent years with advancement in AI technologies in the field of Radiology, interpreting scans and images can be done by AI-based software that produce highly accurate and faster reports. AI can be utilized to identify neurological, cardiovascular, musculoskeletal disorders and even cancer screening.^[12]

Both primary as well as secondary data was collected. Primary data has been obtained from the responses of the online questionnaire filled by the participants and secondary data will be obtained from published articles on AI/ML in healthcare. Relevant literature was reviewed and tabulated in the form of a matrix. Primary data was analysed and presented using graphical representation.

The questionnaire used in the study focuses primarily on awareness and knowledge levels of medical students and healthcare staff. The questionnaire includes three parts viz. demographic details and two sections on awareness, knowledge and perception. The awareness levels were checked on AI in healthcare and applications such as clinical decision support systems, chatbot assistance, and Natural Language processing and in various areas of healthcare viz. public health, drug development, precision medicine, imaging and radiology.

AIMS

1. To understand how well aware medical students and healthcare professionals practising in Nagpur City are, regarding the use of Artificial Intelligence in healthcare.
2. To know how they feel about the future of medical practice with AI/ML tools and how ready they are to accept these technologies.

OBJECTIVES

1. To determine the awareness level, knowledge and perception towards AI/ML in healthcare among healthcare staff and medical staff in Nagpur city.
2. To study the perceptions about AI in healthcare, its future and limitations among medical students and practitioners.

CHAPTER - TWO

REVIEW OF LITERATURE

1. A Study titled “Knowledge, Attitude and Practice of Artificial Intelligence among Doctors and Medical Students in Pakistan: a cross-sectional study” conducted in Pakistan by Zaboora Ahmed et.al, in the year 2022, aimed at determining the extent to which undergraduate and post graduate medical students and practising doctors were aware of the AI algorithms used in healthcare and their attitudes towards AI and deep learning. The team of investigators hypothesized that the sample population were not fully aware and lacked knowledge of the AI applications in healthcare. They found that 71.28% were aware of the basic concepts of AI and deep learning and 76.8% lacked knowledge about any application of AI in medical field. Regarding practice of AI, only 11.3% had ever practically used AI tools in their practice, of which 8.5% had used AI in radiology, imaging and diagnostic purposes, 6.8% had used in histopathology. Overall, a major chunk of healthcare professionals in Pakistan had little knowledge and low awareness levels regarding scope and applications of AI/ML in different aspects of medical field but 66.6% population expressed enthusiasm towards implementation of AI and its ability to reduce errors and aid in diagnosis or treatment. 74% were also optimistic about inclusion of AI as a subject in medical curriculum which will help medical students to work alongside AI in future.^[1]
2. Rohin Kansal et al. conducted a study “ Difference in knowledge and perspectives on the usage of artificial intelligence among doctors and medical students of developing country” in 2022, in which a survey post two webinars to create awareness on AI in healthcare was recorded in Northern India (Punjab). A total of 367 filled the questionnaire and were included in the study. 74.4% feel AI will play a pivotal role in healthcare delivery but 79.6% and 82.8% lacked knowledge about its applications and limitations respectively. Female medical students were more interested than male students in learning about AI tools.^[2]

3. Another study in Canada “ Knowledge and attitudes on artificial intelligence in healthcare” was carried out by Nishila Mehta et al. in 2021, recruited 321 medical students to participate in an exploratory study out of which 288 completed the survey. 83.3% students were aware of general terms rather than specific terms, 71% students were optimistic about the potential of AI in clinical decision-making, 83% believe in AI competency in interpreting images and scans for diagnostic purposes, 53% were of the opinion that AI would be able to personalize drug prescriptions and formulate customized treatment plans. 80% think AI could be used for outbreak prevention and conduct disease surveillance. Many (34%) were not sure if AI could replace humans and reduce their jobs and 79% disagreed that the knowledge gained about AI in current medical curriculum was enough to prepare them for the future^[3]

4. In a study “Awareness of application of artificial intelligence among dental students” in Saveetha University, Chennai, in 2021, dental students were included in a study conducted by Ranjana V. et al. to assess awareness on applications of AI in healthcare. 100 dental students participated in the study of which 51% were female students and 49% were males. 57% were knowledgeable about the basic principles of AI in healthcare and could serve as a powerful tool in predicting clinical outcomes. 48% believed AI will lead to job cuts, 57% were of the opinion that AI should be included in medical curriculum. Female students had a stronger stance that AI will be beneficial for physician’s practice. Male students appear to have more knowledge about AI and thus strongly agree that AI can revolutionize clinical decision making and improve diagnosis. ^[4]

5. A study conducted in India in three premier teaching institutions namely Government Medical College, Chandigarh, All India Institute of Medical Sciences, New Delhi and Bhopal, in 2020, by Ankush Jindal and Manishi Bansal titled “Knowledge and Education about Artificial Intelligence among Medical Students from Teaching Institutions in India: A Brief Survey” in which a total of

226 medical students participated in the study. Majority of students had a basic knowledge of artificial intelligence and internet was the main source of information. 85.6% respondents were optimistic about AI and wanted to learn more about it but any knowledge about a computer language was absent in 73% students. The paper discussed the need to incorporate AI in medical curriculum and computer language such as python and C++ in schools. Also, a considerable percentage of medical students were unaware of journals or articles published on the topic of artificial intelligence in healthcare in the era of technology friendly world.^[5]

6. According to a study conducted in Chennai, India by Samyuktha P S , Geetha R V, and Jayalakshmi Somasundaram published in European Journal of Molecular & Clinical Medicine, 2020, titled “ Awareness and Knowledge about Artificial Intelligence in Healthcare among Doctors- A Survey” aimed at assessing the awareness levels about artificial intelligence in healthcare among doctors concluded that there was an overall positive response from healthcare professionals. Their data revealed that approximately 71% respondents were aware about the basic fundamentals of AI in Healthcare and its scope. Of all, only 55% knew about the specific tools and applications in specialities such as Radiology and Imaging whereas 64% participants had used artificial intelligence-based tools in their practice. 52% believed AI aids in diagnosis and treatment planning. However, 92% were enthusiastic about the future of AI in medicine and its limitless potential. No correlation could be found between variables like gender, age or educational qualification and responses of the survey. ^[6]
7. Simone Castagno and Mohamed Khalifa’s study “Perceptions of artificial intelligence among healthcare staff ” in year 2020, carried out a qualitative survey study to assess the perceptions of healthcare staff about artificial intelligence in healthcare in which healthcare staff viz doctors, nurses, managers and therapists from NHS Foundation Trust, London were invited to complete the

online questionnaire. The response rate of the study was quite low (1.3%) only 98 healthcare staff responded out of a total 7,538. 64% of participants responded that they had never used any AI-based application in their daily practice and 87% were not sure of the difference between ML and deep learning but at least half of the study population were aware of these terms and only 5% had used speech recognition. Further, while investigating about ethical and privacy concerns 80% believed there may be consequential issues with the privacy of patient data. This study discussed that even healthcare professionals in developed countries like the United Kingdom, with highly sophisticated healthcare infrastructure and health systems lack the general knowledge about the topic of AI in healthcare and its applications in medicine. There seems to be a resistance in accepting AI technologies at work for medical workers which may be due to a degree of confusion regarding the subject. Ironically, 72% of participants were not worried that AI will replace human jobs in healthcare. ^[7]

8. Similar to these studies mentioned above another study was conducted in Paris, France by M.C. Lai, M.F. Mamzer and M. Brian named “Perceptions of artificial intelligence in healthcare” in 2020, that aimed to record perceptions about artificial intelligence in healthcare among various healthcare stakeholders. Interviews were conducted either face-to-face or telephonic. The sample include 40 stakeholders from different specialities consisting of radiologists, surgeons, oncologists, dermatologists, and cardiologists etc. Physicians had a positive view about use of AI tool to patient care. They believe AI has the capabilities to save doctors time, better monitor patient health and improve patient safety by alleviating diagnostic and medication errors. Radiologists seem to be the most optimistic to integrate AI into their practice. Responsibility in case of an injury due to AI is a major obstacle in accepting AI into practice. ^[8]

CHAPTER - THREE

METHODOLOGY

STUDY DESIGN : An Observational Cross- Sectional Study.

RESEARCH TYPE : Primary Research

STUDY TYPE : Descriptive Qualitative Study

STUDY SETTING : Nagpur City.

STUDY POPULATION : Healthcare Professionals and medical students in Nagpur City.

- **Inclusion Criteria** – those willing to participate, Medical Students and Practicing Healthcare staff (Doctors, Dentists, Physiotherapists and Nursing staff)
- **Exclusion Criteria** – those who are not willing to participate.

STUDY TOOLS : Self-administered questionnaire and rating scale. (A web-based Google Forms) , MS Excel/SPSS for data analysis.

STUDY DURATION : 03 Months (21/03/22 to 18/06/22)

STUDY TECHNIQUE : Convenience Sampling.

- Medical students and healthcare staff were selected based in Nagpur City and asked to participate in the study. Consent was be taken, and the objectives of the study was explained, anonymity was maintained.

SAMPLE SIZE : 200

RESEARCH QUESTIONS

1. Are medical students and healthcare staff in Nagpur City knowledgeable about artificial intelligence in healthcare and its applications in the field of medicine?
2. What are the perceptions of medical students and healthcare professionals towards the future of AI in healthcare industry?

DATA COLLECTION PROCEDURE

All pre-requisite permissions and consent was obtained from all the participating medical students and healthcare staff. After consent was given, they were requested to fill the online questionnaire using Google Forms. Data collected using google forms is end-to-end encrypted. Responses were limited to one per device to avoid recording multiple responses from same individual and once submitted, responses could not be changed. The responses collected from the participants are visually represented in the form of graphs (pie, bar or line) using MS Excel.

OPERATIONAL DEFINITIONS

Artificial Intelligence - Artificial intelligence (AI), the ability of a digital computers or computer-controlled robot to perform tasks commonly associated with intelligent beings.

Machine Learning - Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves.

Robotic Arms and Robot Assisted Surgeries – A robotic arm is a type of programmable mechanical arms used in surgeries with similar functions to human arm. Robotic surgeries are minimally invasive surgeries with very small incisions performed using robotic arms controlled by surgeons that help in fast recovery and precision.

Natural Language Processing – NLP refers to the ability of computers to understand human language as it is written or spoken as well as a method of communicating with an intelligent system such as English or any other known languages.

Chatbot – Chatbot or Chatterbox is a software application designed to communicate and simulate human conversations through text or voice interactions.

Virtual Personal Assistance – VPA is a digital assistant or an Intelligent Personal Assistance that can perform various tasks of an individual using artificial intelligence.

ETHICAL CONSIDERATIONS

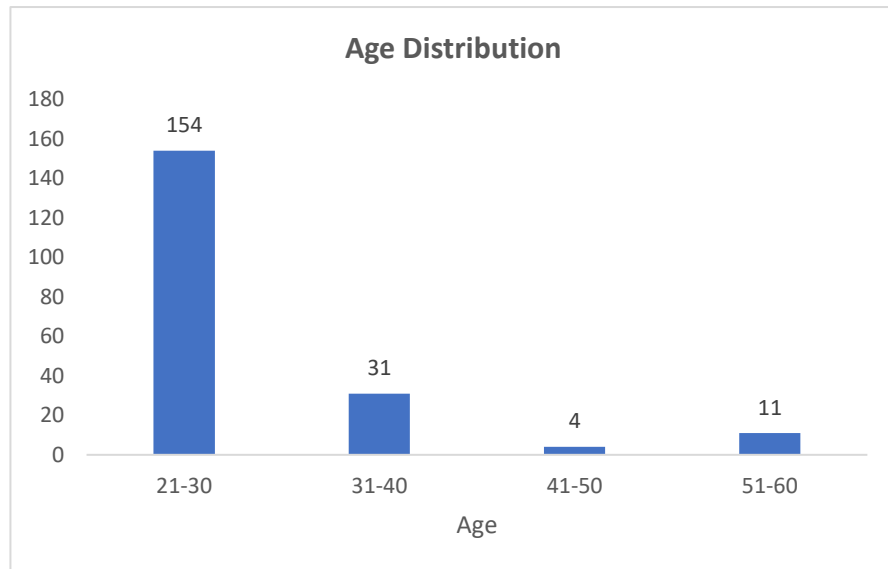
Participants informed consent was taken before enrolling in the study. Confidentiality and anonymity were maintained. All the data gathered was used strictly for research and educational purposes.

CHAPTER – FOUR

RESULTS

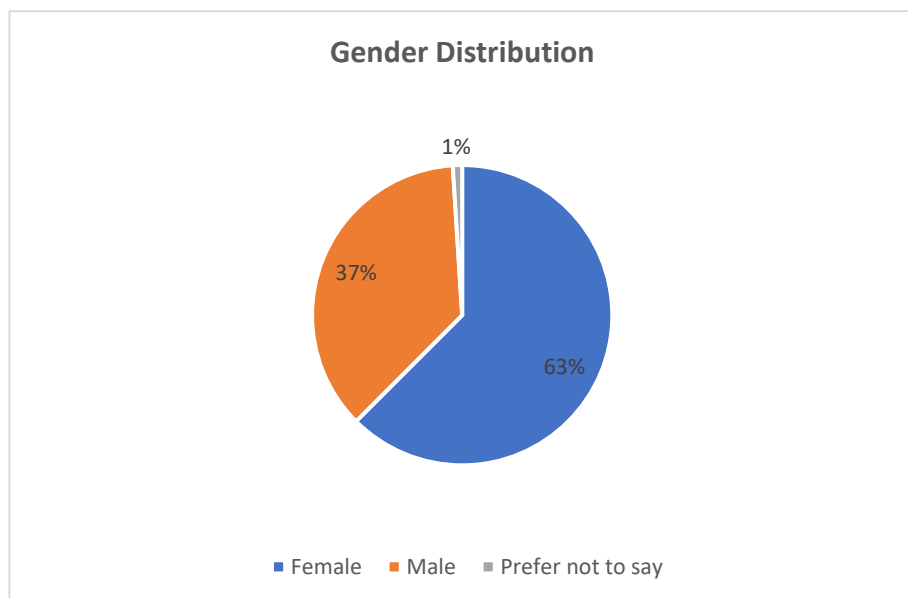
Section 1 : Demographics

AGE



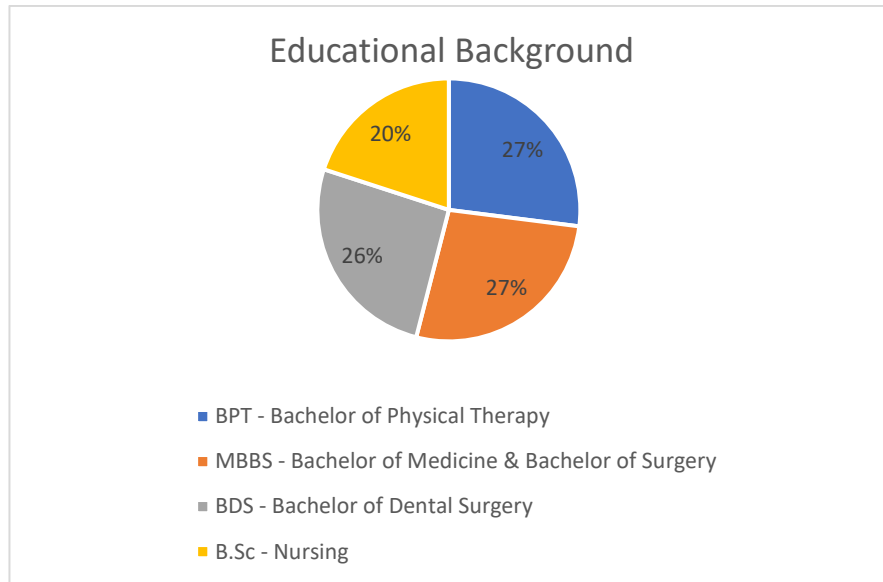
Graph 1 : Bar Graph representing age distribution

GENDER



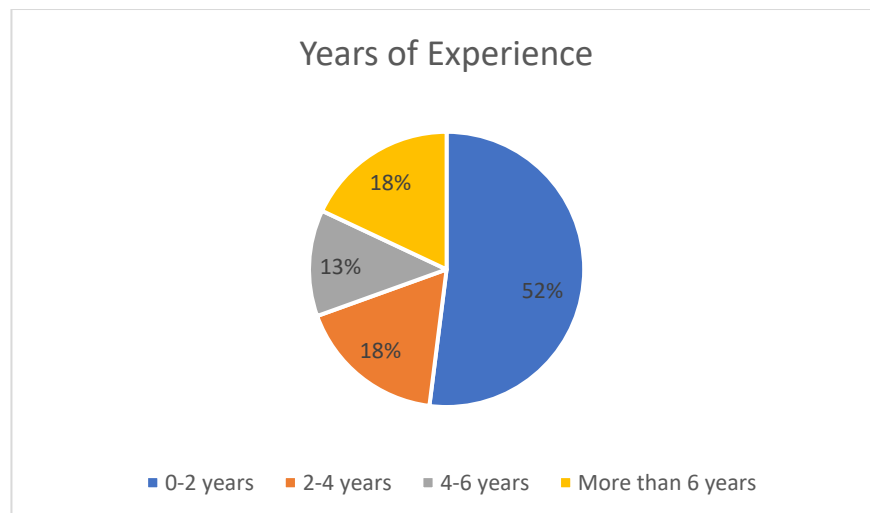
Graph 2 : Pie representing gender distribution

EDUCATION



Graph 3 : Pie representing distribution of educational backgrounds

EXPERIENCE

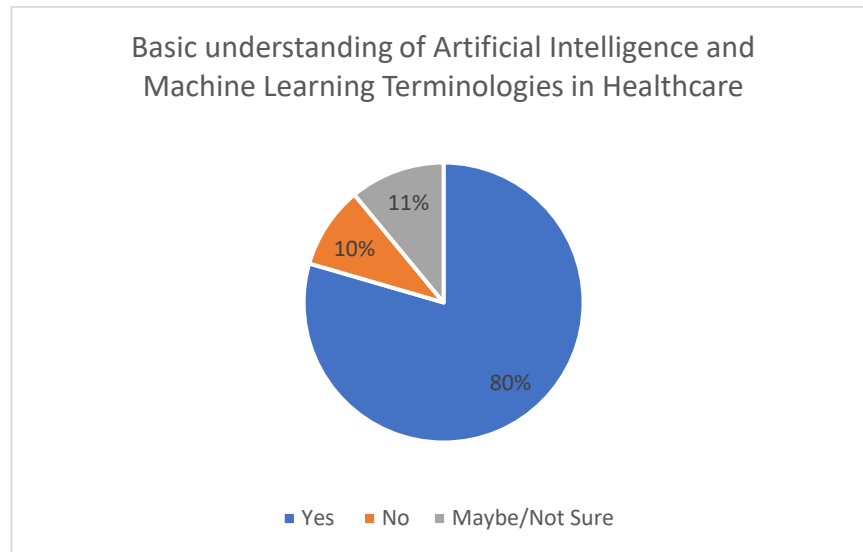


Graph 4 : Pie representing distribution of years of experience

Section 2 : Knowledge, awareness regarding AI in healthcare and its applications

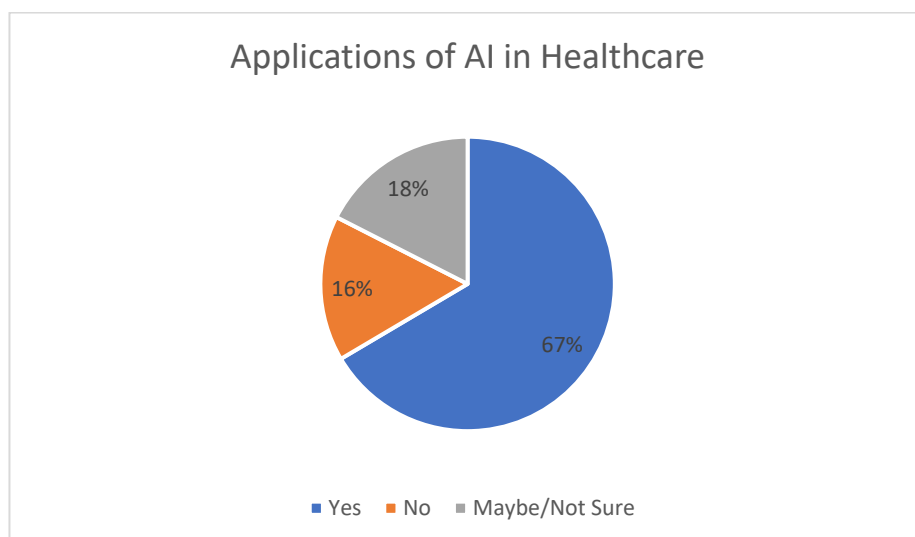
Do you think you have a basic understanding of what Artificial Intelligence is and its common terminologies (such as machine learning) in the field of healthcare? (Graph 5)		
Yes	159	80%
No	19	10%
Maybe/Not Sure	22	11%
Total	200	100%
Are you aware of any applications of AI in healthcare (E.g., Clinical Decision support, Medical IoT Devices, Chatbots etc) (Graph 6)		
Yes	133	67%
No	32	16%
Maybe/Not Sure	35	18%
Total	200	100%
Do you know Artificial Intelligence is currently being used in different areas of medicine such as drug discovery, precision medicine etc ? (Graph 7)		
Yes	130	65%
No	25	13%
Maybe/Not Sure	45	23%
Total	200	100%
Does AI help in aspects of population health (surveillance and outbreak prevention) ? (Graph 8)		
Yes	130	65%
No	10	5%
Maybe/Not Sure	60	30%
Total	200	100%

Table 5 : Frequency and percentage distribution of awareness and knowledge questions



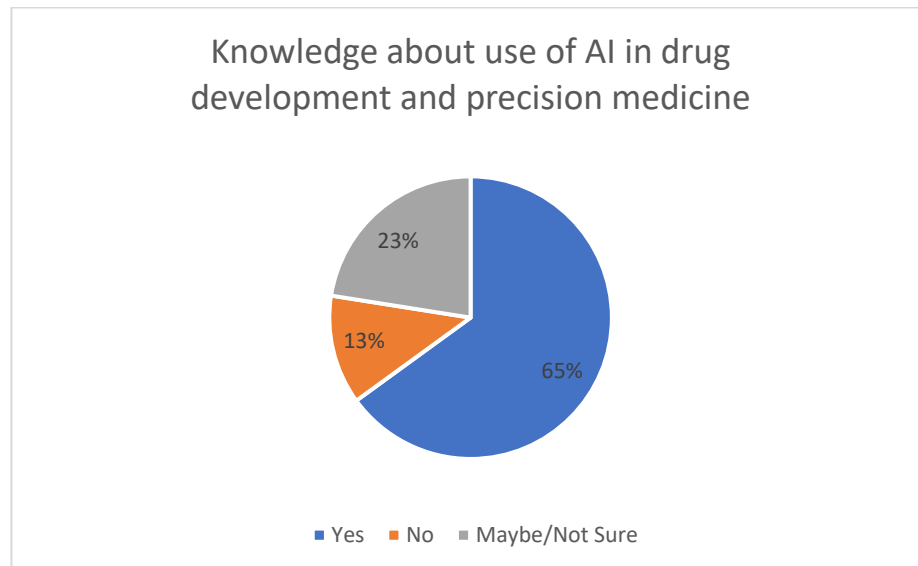
Graph 5 : Pie representing responses of participants on basic understanding of AI in healthcare and common terminologies

The graph represents that majority (80%) of the participants (medical students and working healthcare professionals) are aware of the basic understanding of AI and common terminologies such as machine learning and deep learning. Only 11% were not sure about these terms. A lesser proportion (10%) responded that they were totally unaware.



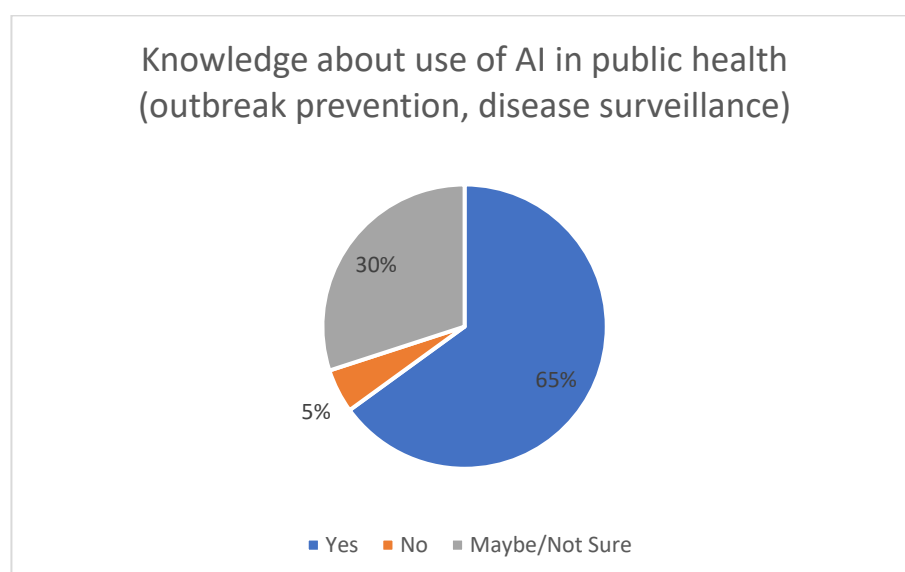
Graph 6 : Pie showing respondents awareness on applications of AI in healthcare

The graph shows 67% of participants are aware of at least some applications of AI in healthcare such as chatbots, virtual nursing assistance, smart wearables and health trackers, or clinical decision support systems. 16% and 18% responded no and maybe respectively.



Graph 7 : Pie showing respondents knowledge on use of AI in drug development and precision medicine

65% doctors and medical students were aware of the use of AI in drug development, in recruitment of participants for clinical trial studies, identifying site of clinical trails and precision medicine specifically in the field of oncology. 23% were unsure about the use of AI in these areas of medicine.



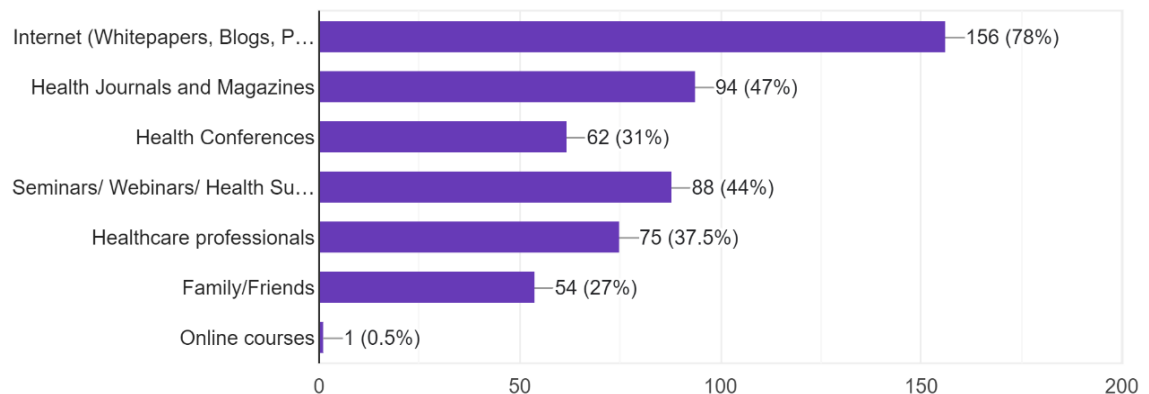
Graph 8 : Pie representing knowledge about use of AI in public health

65% of the population also knew of AI capabilities in the areas of public and population health for disease surveillance, identifying trends and patterns of disease spread to prevent any event of outbreak of disease in community. 30% of individuals were not knowledgeable about the use of AI in public health.

Sources of Information on topics relating to artificial intelligence and machine learning in healthcare

What is your source of information on Artificial Intelligence in healthcare and other Health IT (Information Technology) topics?

200 responses



Graph 9 : Bar graph representing sources of information on AI in healthcare

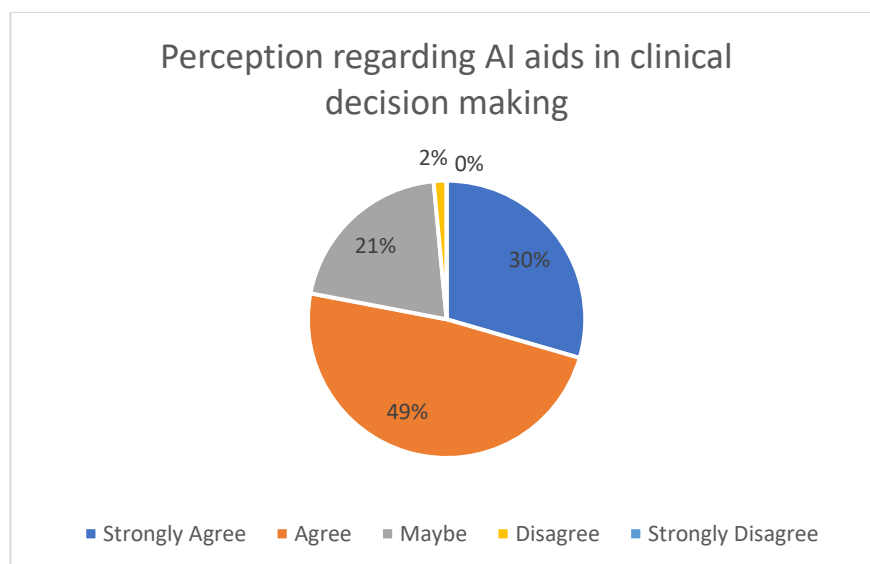
When asked about their sources of information regarding topics like artificial intelligence and machine learning in healthcare, majority responded it was white papers, blogs or articles available in public domain on internet. The second and third most common sources were health journals/magazines and health webinars/seminars respectively. Following these sources was from practicing healthcare professionals itself.

Section 3 – Perception regarding the use of AI in healthcare

Do you believe Artificial Intelligence aids in healthcare professional's clinical decision making? (Graph 10)		
Strongly Agree	59	30%
Agree	97	49%
Maybe	41	21%
Disagree	3	2%
Strongly Disagree	0	0%
Do you believe AI applications have the potential to revolutionize patient care in the future? (Graph 11)		
Strongly Agree	62	31%
Agree	91	46%
Maybe	44	22%
Disagree	3	2%
Strongly Disagree	0	0%
Do you believe that using voice recognition & Natural Language Processing tools will benefit healthcare professional's practice by saving hours of their time that is wasted in routine tasks (refilling prescriptions, scheduling appointments etc)? (Graph 12)		
Strongly Agree	64	32%
Agree	96	48%
Maybe	37	19%
Disagree	3	2%
Strongly Disagree	0	0%
Can Artificial Intelligence be used for accurate diagnosis and treatment Planning of patients? (Graph 13)		
Strongly Agree	48	24%
Agree	72	36%
Maybe	63	32%

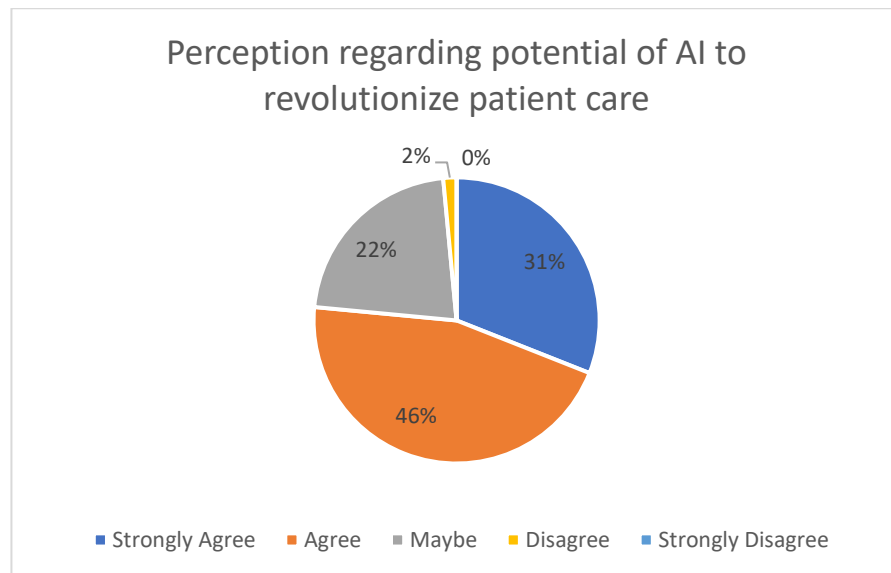
Disagree	14	7%
Strongly Disagree	3	2%
Does the existing medical education curriculum in India prepare healthcare professionals to work alongside AI in future? (Graph 14)		
Strongly Agree	35	18%
Agree	61	31%
Maybe	54	27%
Disagree	38	19%
Strongly Disagree	12	6%

Table 7 : Frequency and percentage table for questions on perception regarding AI in healthcare



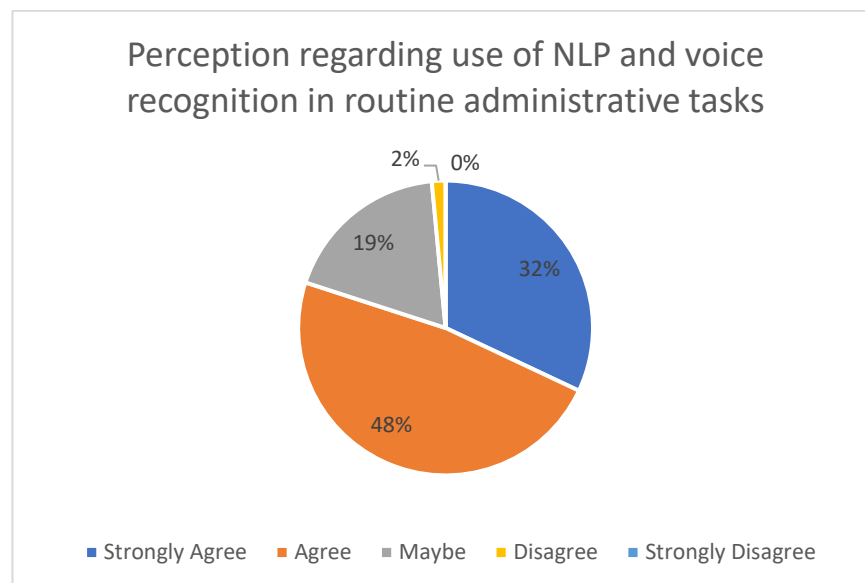
Graph 10 : Perception regarding the use of AI in clinical decision-making

A total of 156 participants either strongly agree or agree that AI aids in clinical decision making. The use of clinical decision support systems has made it possible for machines to accurately diagnose and predict health outcomes by analysing health records and learning from past experiences. 21% were not sure of or had never come across such AI-based applications in their practice.



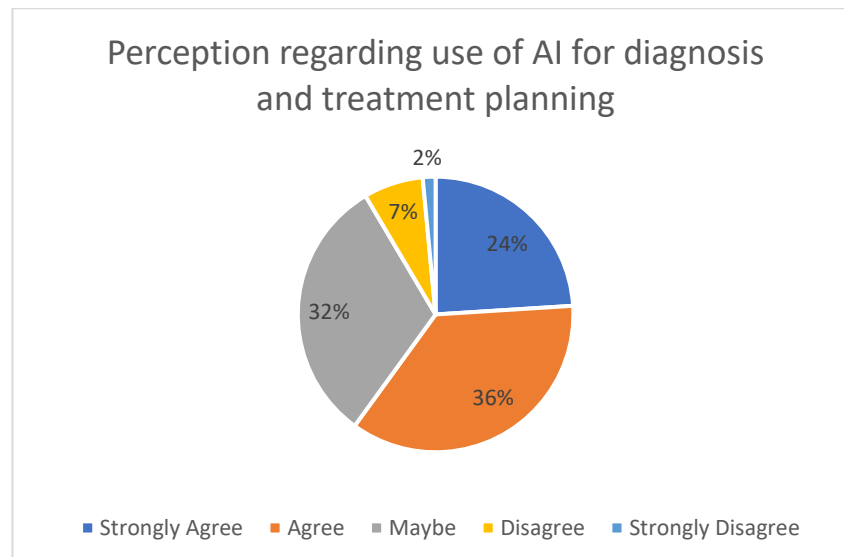
Graph 11 : Perception towards the potential of AI in revolutionizing patient care

77% (153 out of 200) of participants were of the perception that AI has the potential to revolutionize patient care standards. 44 (22%) did not have any opinion on the question and marked maybe.



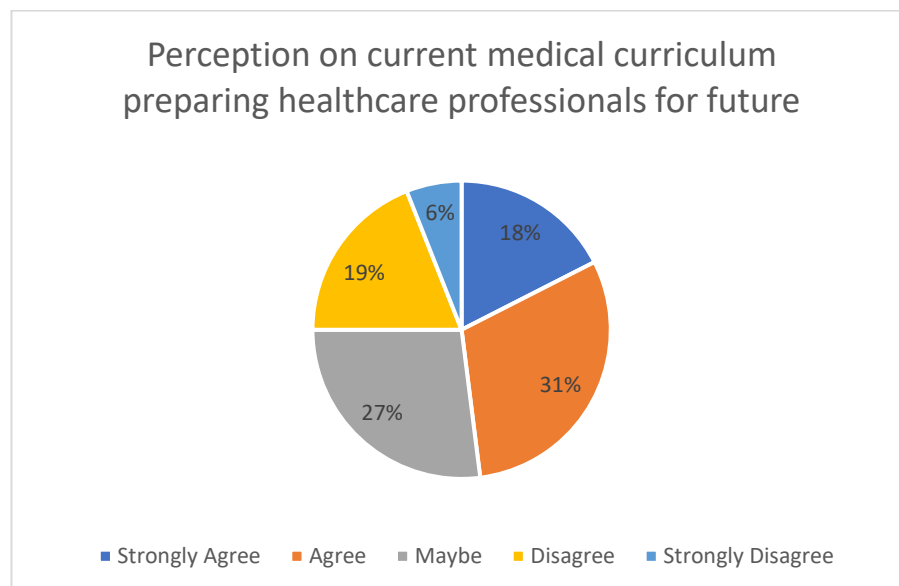
Graph 12 : Perception regarding using NLP tools in routine practice

Majority (80%) believed that use of voice recognition, speech-to-text tools and Natural language processing tools can save time of physicians wasted in routine administrative tasks, such as making notes, prescriptions and scheduling appointments.



Graph 13 : Perception regarding accurate diagnosis and treatment planning using AI software

58% population believes that accurate diagnosis and treatment planning could be done using AI based applications. 32% (63 out of 200) were unsure of such capabilities and competency of artificial intelligence.



Graph 14 : Perception on whether the current medical curriculum prepares doctors to work alongside AI in future

25% respondents don't agree (either expressed disagreement or strong disagreement) that the current medical education in India is preparing doctors, and other healthcare professionals for working alongside AI in the future. They also believed that AI, as a subject should be added to the curriculum to better understanding of the matter and were enthusiastic to learn more about the same. Rest 27% were unsure and 49% agreed that current education is sufficient to prepare doctors for a technology driven practice in future.

CHAPTER – FIVE

DISCUSSION

Most of the participants belonged to age group 21-30 with median age of 26 years. 38% of the population identified as male and 62% female. 27% (54 out of 200) and 27% (54 out of 200) individuals had studied BPT and MBBS as the graduation degree and 26% (52 out of 200) were dental graduates and remaining 20% (40 out of 200) had pursued B.Sc. Nursing. Almost half of the sample population included medical students and the other half were working professionals. Of the working healthcare practitioners, 18% had 2-4 years of experience, 13% had been working for 4-6 years and another 18% had more than 6 years of total experience. In the knowledge section of the questionnaire, 80% of medical students and practicing professionals accepted that they had a basic understanding of AI in healthcare and heard of the common terminologies used. Approximately 65% were knowing about the applications of AI in various fields of medicine used for new drug development and medical triaging. The most common source of information was through internet and health journals. In the perception section of the questionnaire, a significant proportion of population (49%, 48% and 46% resp.) were unsure of the contribution of AI in clinical decision-making, accurate diagnosis and treatment planning, and use of NLP tools to save physician's time. Many (25%) disagreed that the current medical curriculum is preparing doctors to work alongside AI in future.

LIMITATIONS

In order to encourage participation and completion of the survey, the questionnaire had to be short and crisp which included only 10 questions excluding demographic details. A relatively smaller sample size was taken owing to the limited time span for data collection and subsequent analysis. Also, as medical students and working healthcare professionals were targeted, the study could not be generalized to a larger population. Many healthcare professionals could not complete the questionnaire due to some reasons or did not respond even after constant reminders. A larger proportion of respondent pool identified themselves as female, which is consistent with the male to female ratio in medical education (BDS, BPT and B.Sc. Nursing). The male to female ratio was almost equal in students studying MBBS.

CHAPTER - SIX

RECOMMENDATIONS

Though the incorporation of AI/ML as a subject in medical curriculum cannot happen overnight and requires time. But it should be noted that a gap exists between the awareness and knowledge of medical students about such technologies and the actual use of AI in medical practice and its applications.

The current medical curriculum must be revised to include subjects such as AI in healthcare. Students must be encouraged to learn about a computer language early on during the first or second year of their medical education.

Students can also be encouraged to take on online courses on any online learning platforms such as coursera or udemy etc which can serve as a great way to be accustomed to any new developments in health-tech industry.

Participating in Seminars or health conferences, where new topics are discussed, and research papers are presented will also boost knowledge about AI which can break barriers of acceptance among medical students and healthcare professionals.

Workshops can be conducted as a part of CME programs (Continuing Medical Education) which serve to develop a better understanding of the subject and maintain relationships with instructors which can be helpful for their upskilling.

CHAPTER - SEVEN

CONCLUSION

AI/ML in healthcare is rapidly gaining attention and giving intriguing results when it comes to its accuracy and ability to give faster results and save millions of dollars and increase accessibility to healthcare in lower- and middle-income countries which lacks trained physicians and has poor healthcare infrastructure. Yet, medical students and healthcare professionals are not fully aware of the competencies and capabilities of AI and thus are reluctant to accept it into their practice. The need of the hour is that medical students, who are going to play a pivotal role in the future of medicine, be fully aware and knowledgeable about the use of AI in different fields and be familiar with various AI-based tools.^[9]

Artificial Intelligence in healthcare is a topic of decision in the healthcare industry owing to its potential to ease in diagnosis, treatment and surgery. It has the capability to revolutionize patient care and future of medicine. Hence it is of utmost importance that medical professionals are aware about its scope and applications in healthcare as they can then spread awareness among the general mass and influence the acceptance of artificial intelligence technologies in healthcare and hospitals. Adoption of AI/ML in healthcare will play a major role in diagnosis and patient care as well as automate the administrative functions in hospitals and thus can increase the efficiency of healthcare staff.^[10]

Though, the digital era has made it extremely easy to educate oneself regarding upcoming technologies and new developments in modern medicine, including these topics in medical curricula will ensure that every medical student has knowledge of the basic principles of technologies like AI/ML in order to thrive in the technology-driven healthcare industry.

In this study, it was found that medical students and healthcare professionals in Nagpur city are optimistic regarding the current usage of AI/ML in healthcare and the future. Though, there are some barriers to implementation of AI in Indian healthcare systems, the most evident is the responsibility in case of any injury or even death due to AI-based systems. The stakeholders should clearly define a sense of responsibility in any event of mishap or injury. Another barrier is privacy issue, due to the highly confidence and sensitive nature of the data in healthcare, as AI capabilities will grow the threat of

cyberattacks will also increase. For the same reasons, providers as well as patient find it hard to accept such technologies in their practice or clinical encounter. As AI is constantly evolving and new developments are taking place across the globe, AI will be adopted into healthcare practice sooner than ever in form of EHRs, HMIS and other hospital operating systems.^[11]

Similar studies conducted in India and other lower- and middle-income countries also found the same results as this study that medical students lack access to technologies or software due to limited resources and opportunities. Perception regarding AI were also comparable with similar studies, medical students were optimistic to learn about AI-based technologies and software but either had never used such technology in practice or came across during internship or education. Given opportunities, and some proactiveness from the students side can make a huge difference and help tackle challenges of unacceptance in doctors, paramedics, dentists and nurses.

Artificial Intelligence is set to disrupt the healthcare industry as it has its applications in almost all fields and researchers are further exploring novel areas in which AI can be beneficial for revolutionizing patient care and aid in physician practice to build a world with high patient safety standards.

In the future, AI and predictive analytics will be able to accurately predict when a person is at the risk of developing a chronic disease like diabetes, hypertension and even oncogenic tumors. AI will also work to reduce burnout rates in healthcare professionals by reducing a large number of patients in peak seasons of diseases like flu season to overwhelm healthcare facilities and hospitals to see their PCP (Primary Care Provider) by an umbrella term called connected care wherein hospitals will focus only on providing critical care to acutely ill patients and less urgent cases will be treated in retail clinics, home-based care models or even entirely remotely. This will reduce wait time, improve patient satisfaction, increase efficient clinical workflows and ultimately lead to reducing the administrative burden.^[12]

Thus, enough emphasis should be laid on imparting formal trainings and educating doctors of tomorrow about Artificial Intelligence and its capabilities. Multidisciplinary approach can be adopted especially for those wanted to gain more knowledge and develop skills in the field, like incorporating elective courses to intrigue an interest in the subject.

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ANNEXURES

Annexure 1 : Artificial Intelligence in Healthcare Awareness Questionnaire

Part 1 – Demographic Details

- Name
- Age
- Gender
 - Male
 - Female
 - Prefer not to say
- Education
 - MBBS
 - BDS
 - BPT
 - B.Sc. Nursing
- Years of Experience
 - Student
 - 0-2 years
 - 2-4 years
 - 4-6 years
 - More than 6 years

Part 2 – Awareness and Knowledge

Q1. Do you think you have a basic understanding of Artificial Intelligence and common terminologies (such as machine learning) in the field of healthcare?

- Yes
- No
- Maybe/ Not sure

Q2. What is your source of information on Artificial Intelligence in healthcare and other Health IT (Information Technology) topics?

Internet (Whitepapers, Blogs, Podcasts, Published Articles)

Health Journals and Magazines

Health Conferences

Seminars/ Webinars/ Health Summits

Healthcare professionals

Family/Friends

Other _____

Q3. Are you aware of any applications of AI in healthcare (Eg. Clinical Decision support, Medical IoT Devices, Chatbots etc)

- Yes
- No
- Maybe/ Not sure

Q4. Do you know Artificial Intelligence is currently being used in different areas of medicine such as drug discovery, precision medicine etc ?

- Yes
- No
- Maybe/ Not sure

Q5. Does AI help in aspects of population health (surveillance and outbreak prevention) ?

- Yes
- No
- Maybe/ Not sure

Part 3 – Perception

Q6. Do you believe Artificial Intelligence aids in healthcare professional's clinical decision making?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Q7. Do you believe AI applications have the potential to revolutionize patient care in the future?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Q8. Do you believe that using voice recognition & Natural Language Processing tools will benefit healthcare professional's practice by saving hours of their time in routine tasks (refilling prescriptions, scheduling appointments etc)?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Q9. Can Artificial Intelligence be used for accurate diagnosis and treatment Planning of patients?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

Q10. Does the existing medical education curriculum in India prepare healthcare professionals to work alongside AI in future?

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
