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Human Factors in Health AI: Knowledge and Attitude Assessment of Healthcare Workers

Mahabub Basha S

Assistant Professor, Department of Commerce, IIBS, Bangalore

Email: Shaiks86@gmail.com

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Abstract: *Artificial intelligence is revolutionising the healthcare sector by assisting and improving the quality of care provided to the patient with illness and easing the care delivery. The main objective of the study was to assess the level of knowledge and attitude of the healthcare workers towards the implementation and use of artificial intelligence in the healthcare sector. The data was collected using structured knowledge questionnaire and five point Likert scale which was circulated among the social media groups of different medical college and hospitals. The online survey was responded by a total of 199 healthcare workers among which 48 were doctors, 41 were staff nurses, 5 respondents were Radiologists, 40 respondents were nursing students, 56 the majority of the respondents were medical students and 9 respondents were radiology technicians. The data was analysed using statistical techniques. The findings of the study stated that: Out of 119 healthcare workers, 121(60.80%) had inadequate level of knowledge and 67(33.66%) had moderately adequate knowledge and 11 (5.52%) of them had adequate knowledge regarding Artificial intelligence in healthcare Correlation between knowledge and attitude score: The data analysis was done for the correlation between knowledge and attitude score using Karl Pearson's coefficient of correlation formula. The findings rxy=0.0041392 since 0< rxy < 1, hence there is a positive correlation between knowledge and attitude scores*

Keywords*: Human Factors, Health Economy, Artificial Intelligence*

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Introduction:

Artificial Intelligence (AI), where work is done using computers which usually requires Human intelligence. Artificial Intelligence has become the topic of discussion in every field of science and Engineering. Artificial intelligence is an broad term which describes the machine learning algorithms and software in the process of analyzing presenting and comprehension of medical data and healthcare data. It is the ability of the computer algorithms which approximates the conclusions which are based only upon the input data.

The main distinguishing factor between the traditional technology and the Artificial Intelligence technology in healthcare is that the ability of the technology in gathering, processing and providing well-defined and accurate output to the end user. The primary goal of the Artificial Intelligence application in healthcare is to analyze the relationship between techniques of treatment and patient outcome. The diagnosis process, development of treatment protocol, development of drug, monitoring patient and care and personalizing medicine are some of the Healthcare practices where the Artificial intelligence is applied.

Artificial Intelligence for Intelligent healthcare system

In early 1956, John McCarthy, Marvin Minskly, Claude Shannon's and Nathaniel Rochester framed the term **Artificial Intelligence**. Artificial Intelligence is a computer programme that completes a task like that of human intelligence but more independently and intelligently. Artificial Intelligence is a prompt tool to support the healthcare administration. Many studies have proven that Artificial Intelligence algorithms are very capable of providing precise diagnosis for patients medical data. Artificial Intelligence can be utilized for the simplification of patients, doctors and hospital administrator lives by performing tasks that are usually carried out by humans at a minimum cost and time to less time utilization and less time consumption for the analysis of medical data. The healthcare industry is changing with the pace of time and technology and has endless opportunities from, cancer and chronic diseases to risk assessment and radiology for the implications of Artificial Intelligence in conveying more precise, impactful, efficient implications that are needed in patient care.

Implication of Artificial Intelligence which is currently saving lives,

PATHAI is developing technology of machine learning to assist clinical pathologists in making accurate cancer diagnosis. The aim of the technology is to reduce the human errors in cancer diagnosis and individualized medical treatment method developments with Artificial Intelligence.

BUOY HEALTH is an intelligent Artificial Intelligence based symptom checker and treatment provider. It provides perfectly planned treatment for the illness by analysing the symptoms of the patient. The Harvard Medical School is the only one healthcare provider to utilize this technology.

FREENOME is an Artificial intelligence technology in blood test and diagnostic screening which detects the cancer at its earliest stage and provides a treatment plan.

CATALYST.AI, HEALTHCARE.AI were developed by the HEALTHCARE CATALYST company as Every ailment or medical condition is difficult for physicians and nurses to identify though they train extensively, in recent times helping critically ill patients due to Covid-19 outbreak was difficult. This technology has the capability to identify the high risk patients and guides the clinicians for readmission of those patients, also helps in predicting chronic diseases and hospital acquired infections.

OKWIN is a company which is improving the pharmaceutical industry with the application of Artificial Intelligence powered medical research and drug development where disease evaluation is done with creating models by using machine learning algorithms and enhances the drug development process, creating drugs with lesser side effects

Dermatology

Speciality of abundant imaging and deep learning development has tied with image processing. Hence Dermatology and deep learning (AI), basically there are 3 main types of dermatology imaging: macro images, contextual images and micro images. Deep learning has shown great progress for each modality. Han et.al, showed face photographs detecting keratinocytic skin cancer. Esteva et.al, showed classification of skin cancer at dermatologist level from lesion images.

Radiology

Computerized Tomography and magnetic Resonance Imaging are utilized by the field of radiology to detect and diagnose diseases within an individual. According to the Radiology Society of north America the focus upon the Artificial Intelligence utilization in radiology has increased rapidly in recent years with a growth from 0 to 3 from 2015-2018. An algorithm was created during a study at Stanford which could detect pneumonia in patients. The utilization of AI also helped in detection of oncology problems through imaging. The Artificial Intelligence has become so prominent that the Radiological Society of North America during its annual conference has implemented presentations on Artificial Intelligence in Imaging.

a. Machine learning- Deep learning and neural network
b. Natural language processing
c. Rule based expert system
d. Robotic process automation
e. Diagnosis and treatment applications
f. Patient engagement and Adherence applications
g. Administrative applications

Machine learning- Deep learning and Neural Network

Machine learning can be described as statistical techniques were data is used in the process of training and learning. Machine learning can be described as one of the common form of Artificial intelligence. in healthcare the use of machine learning can be seen traditionally in precision medicine, where prediction of the treatment protocols are done to understand which treatment protocols are very much likely to succeed on the patient based on the patients attributes and the context of the treatment. The majority of precision medicine application and machine learning requires a data set for which the variables of outcome are known which is called as supervised learning.

Natural Language processing

Since 1950s many of the Artificial intelligence researchers made making sense of human language as their goal. The field of Natural Language processing includes application such as analysis of text, recognition of speech, translation and many goals which were related to the language. The approaches to it are basically classified as Statistical Natural language processing approach and semantic natural language processing approach. The Statistic natural language processing is mainly based on machine learning particularly deep learning neural network. Which contributes mainly to the recent increase seen in accuracy of recognition, it requires a large body language from which to learn.

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Rule based expert systems

In 1980s and in the later periods the Expert systems based on collection of rules were the dominant technology of artificial intelligence which was used commercially. Later employed in the field of healthcare mainly for the purpose of clinical decision support and are widely used still toady. Even today many of the Electronic Health Record (EHR) provides furnish a set of rules with their system. The expert system requires human expertise and knowledge full engineers to construct a set of rules in the particular domain of knowledge. They are very easy to understand and also work well. They tend to break down when the number of rules are large in number and starts conflicting with each other. If the domain of the knowledge changes it will be difficult to change the rules and would be time consuming too. They are being replaced in the field of healthcare slowly by more other approaches based on data and machine learning algorithms.

Robotic Process Automation

For the administration the robotic process automation performs structured tasks that is those involving in informative system as if they were human users following a scripted rules. These are an least expensive when compared with other Artificial intelligence technologies and are very easy to programme and very transparent in their actions. As the name the Robotic process automation does not really involves the use of robots but a computer programme with a server. They are mainly relied upon the combination of workflow, presentation layer and business rules integrated with information system where they act like semi-intelligent user of the system. In the field of healthcare they are mainly used for the repetitive tasks like prior authorisation, billing and updating patient records. When they are combined with different Artificial intelligence technologies they can be used for more functions like image recognition and extraction of data.

Diagnosis and treatment application

Since 1970s the diagnosis of the disease and provision of the treatment were the main focus of the Artificial intelligence. Some of the systems which were developed like MYCIN by the Stanford for the diagnosis of the blood borne bacterial infections they showed promisingly good results for accurately diagnosing and treating the diseases but were not adopted by the industry for the clinical practices. They were not better than the human diagnosticians and were with poor integration of clinical workflow and medical record system in them.

Patient engagement and adherence applications

Seen as the last mile problem of healthcare, the barrier between good and ineffective health outcome, as the more number of patients take part in their own well being the better the outcome. These were the factors which were being increasingly addressed by the big data and Artificial intelligence.

Administration applications

There a number of other Artificial intelligence applications for the administrative purposes in the healthcare field. The use of Artificial intelligence in the administrative department is very less revolutionary when compared with patient care area.

Though Artificial Intelligence holds potential and advantages in improving the healthcare system faces a lot of challenges in healthcare system such as,

- The adaptation of the technology in a healthcare system and the cost of training employee is much more high.
- Differences among the technologies utilized among the hospitals.
- Fear and hesitation towards the use of Artificial intelligence among the healthcare team.
- Lack of skills and knowledge in representation of the displayed data.
- Lack of trust towards the Artificial intelligence leading to reanalysis of the medical data consuming time and money.
- Expensive information and technology infrastructure for storing the offline data.
- Proper, systematic and strong electronic health record system is required for the effective process of Artificial intelligence.

The advantages of Artificial Intelligence implication in healthcare system are,

- Enables the healthcare team in sharing the knowledge and expertise in decision making process.
- Precise and accurate disease diagnosis improves the treatment quality provided.
- The stored medical data can be utilized in investigating new medical solutions.
- Enables proper course and design of telemedicine for the patient's health improvement.
- Artificial Intelligence reduces the amount of time spent, cost and human errors in treatment process.
- With accurate diagnosis the quality of decision making improves.
- With precise, accurate and quality disease diagnosis reduction of patient mortality and morbidity is reduced.
- Less data analysis time improve proper management of inpatient and outpatient departments.
- Used in creation of future models of epidemic, endemic and pandemic diseases in reducing the spread all over the world.

Review of literature:

Simone Castagno and **Mohamed Khalifa** conducted a study on the perception of Artificial Intelligence Among the Healthcare staff. The aim of the study was to understand the perception of radiology professionals working at Royal Free Hospital, London, United Kingdom towards Artificial intelligence. The objective of the study was to assess the Artificial Intelligence awareness among the healthcare professionals as the medical community has an agreement towards the radical impact of Artificial Intelligence towards patient care in future. The survey was taken by a number of 98 Healthcare professionals including Doctors, Therapists, Managers and Nurses. The data was analysed and the analysis stated that majority of the respondents 87% never came across the difference between machine learning and Deep learning, the number of respondents who never came across the application of Artificial Intelligence in there work were about 64%, 54% of the respondents knew at least one of between machine learning and Deep learning, the daily bases usage of Speech Recognition and the transcription application was done by only 5% of the respondents, were as 63% of the respondents never utilized either of them. Majority of the respondents believed that there may be issues with privacy while using Artificial Intelligence were about 80% , bout 40% of the respondents believed that Artificial Intelligence may be even more dangerous than Nuclear Weapon, 79% of the respondents were confident that Artificial Intelligence would be very useful in their field and the respondents who were feared about being replaced at work by the Artificial Intelligence were only 10%. The study concluded that many of the healthcare professionals do not have full understanding of Artificial Intelligence.

A survey study was conducted by **Jaideep Sur, Sourav Bose, Fatima Khan,Deeplaxmi Dewangan, Ekta Sawriya** and **Ayesha Roul** on the Knowledge, Attitudes and perceptions towards Artificial Intelligence future in Oral Radiology in India. The main aim and objective of the study were to investigate the knowledge, perception and Attitude towards Artificial Intelligence future in radiological diagnosis among the Dental specialist in Central India. The data was collected using a closed ended questionnaire with a number of 15 questions using Google forms the questionnaires were circulated online among the Dental specialists working in Central India. The questions were regarding the participant's attitude, recognition regarding the Artificial Intelligence and their opinion on further development in Artificial intelligence. The survey was undertaken by a number of 250 respondents who were Dentists, the majority of the respondents agreed that they were expecting to use Artificial Intelligence in ruling Dental diagnosis, 68% of the respondents were very much familiar with the concept of Artificial Intelligence, 51% of the respondents agreed that the Artificial Intelligence would be of use mainly in the interpretation of complicated Radiological scanning, 63% agreed with statement that Artificial Intelligence would have a Future in India. The study concluded that the Dental Specialists were very well aware about the concept of Artificial Intelligence and would be used in doing precision diagnosis of complicated cases.

A survey study was conducted by **Jaideep Sur, Sourav Bose, Fatima Khan,Deeplaxmi Dewangan, Ekta Sawriya** and **Ayesha Roul** on the Knowledge, Attitudes and perceptions towards Artificial Intelligence future in Oral Radiology in India. The main aim and objective of the study were to investigate the knowledge, perception and Attitude towards Artificial Intelligence future in radiological diagnosis among the Dental specialist in Central India. The data was collected using a closed ended questionnaire with a number of 15 questions using Google forms the questionnaires were circulated online among the Dental specialists working in Central India. The questions were regarding the participant's attitude, recognition regarding the Artificial Intelligence and their opinion on further development in Artificial intelligence. The survey was undertaken by a number of 250 respondents who were Dentists, the majority of the respondents agreed that they were expecting to use Artificial Intelligence in ruling Dental diagnosis, 68% of the respondents were very much familiar with the concept of Artificial Intelligence, 51% of the respondents agreed that the Artificial Intelligence would be of use mainly in the interpretation of complicated Radiological scanning, 63% agreed with statement that Artificial Intelligence would have a Future in India. The study concluded that the Dental Specialists were very well aware about the concept of Artificial Intelligence and would be used in doing precision diagnosis of complicated cases.

A survey Conducted by B. Mahammad Rafee et al (2023) opined that, India's economy has been significantly impacted by COVID-19, with a 3.1% increase in Q4 2020 and a 24% decrease in Q1 2020. Unemployment dropped to pre-lockdown levels in mid-June, and 140 million people lost jobs during the lockdown. The Indian economy is predicted to lose over 32,000 crore (US 4.0 billion) a day during the lockdown. A study conducted in Chennai, Tamilnadu, investigated the issues faced by non-Covid patients and healthcare services during the pandemic. Results showed that 53.41% of participants believed there were no facilities for testing their illnesses during the pandemic, and 30.97% claimed there were no doctors, beds, ICU facilities, or medications. A significant challenge for non-COVID patients was a lack of funds and transportation, with 55% not having enough money to pay for hospital visits and Medicare. The study also found a negative link between doctor availability and online consultation services for non-COVID patients. The study concludes that women and men face significant differences in healthcare access, medical equipment availability, extended health infrastructure facilities, and insurance awareness.

Objectives:

1. To assess the level of knowledge regarding Artificial Intelligence among healthcare workers.
2. To assess the attitude of healthcare workers towards the implementation of Artificial Intelligence.
3. To find out co-relation between knowledge and attitude scores of healthcare staff.
4. To find out association between knowledge score and their selected demographic variables.
5. To find out association between Attitude score and their selected demographic variables.

Research Methodology:

In view of the nature of the problem selected and the objectives to be accomplished, a descriptive research approach was considered appropriate for the present study. Research design used for the proposed study was experimental descriptive design to assess the knowledge and attitude regarding the implementation of Artificial Intelligence among the healthcare workers. In the present study the samples are 199 Healthcare workers [Staff nurses, Doctors, Radiologists, Therapists, and undergraduate Nursing and Medical students, Paramedics etc].

Data collection & Analysis:

Data analysis is the process of organizing and synthesizing data so as to answer research questions and test hypothesis

Analysis and interpretation of data was based on projected objectives of the study, that is:

1) To assess the level of knowledge regarding Artificial Intelligence among healthcare workers.
2) To assess the attitude of healthcare workers towards the implementation of Artificial Intelligence.
3) To find out co-relation between knowledge and attitude scores of healthcare staff.
4) To find out association between knowledge score and their selected demographic variables.
5) To find out association between Attitude score and their selected demographic variables.

HYPOTHESIS

1) H0: There is no Association between Age and knowledge regarding Artificial intelligence among Healthcare Workers
2) H0: There is no Association between Qualification and knowledge regarding Artificial Intelligence among Healthcare Workers
3) H0: There is no Association between Gender and knowledge regarding artificial intelligence among the Healthcare Workers
4) H0: There is no Association between Age and Attitude regarding Artificial intelligence among healthcare workers
5) H0: There is no Association between Qualification and Attitude regarding Artificial Intelligence among Healthcare Workers
6) H0: There is no Association between Gender and the Attitude regarding artificial intelligence among the Healthcare Workers

The data was collected through:

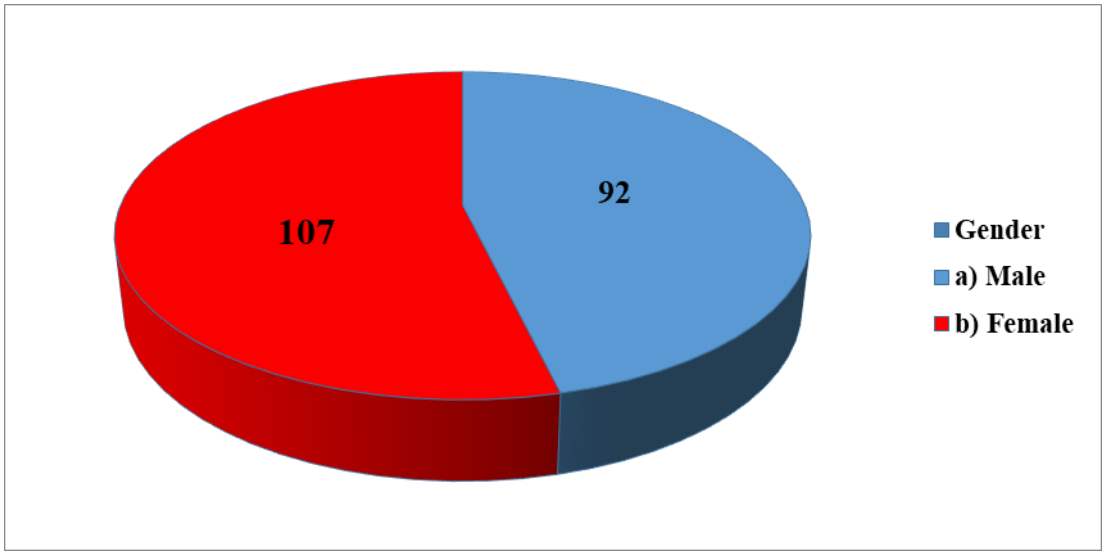
- **Structured knowledge questionnaires**
- **Five point modified Likert scale**

The sample consisted of 41 Nurses, 48 Doctors, 05 Radiologist, 09 Technicians, 40 Nursing Students, 56 Medical students working and studying at Al Ameen Medical College Hospital Vijayapur and Bangalore

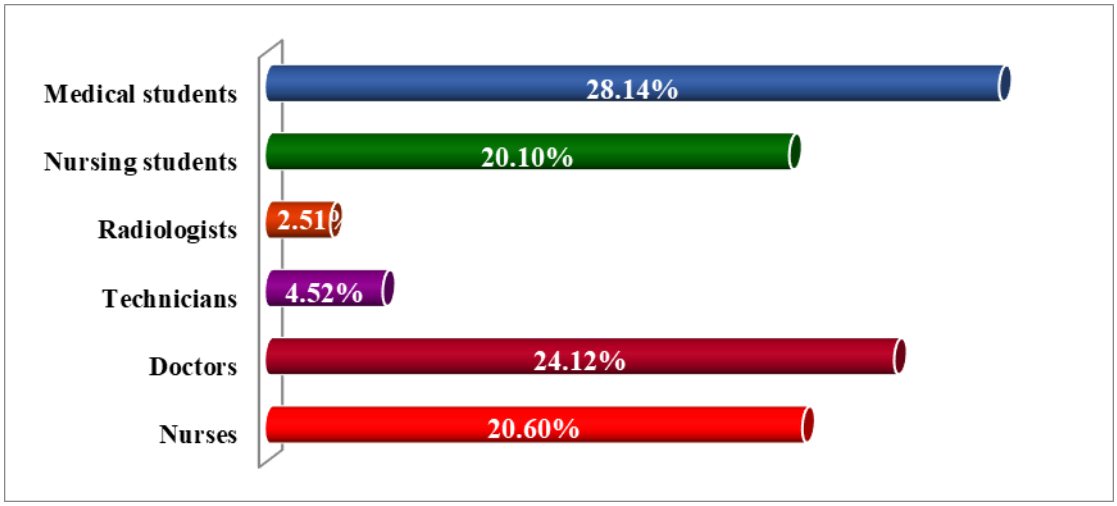
Section 1: Distribution of sample characteristics according to demographic variables of respondents.

Table 2: Frequency and percentage distribution of Staff Nurses according to socio demographic variables

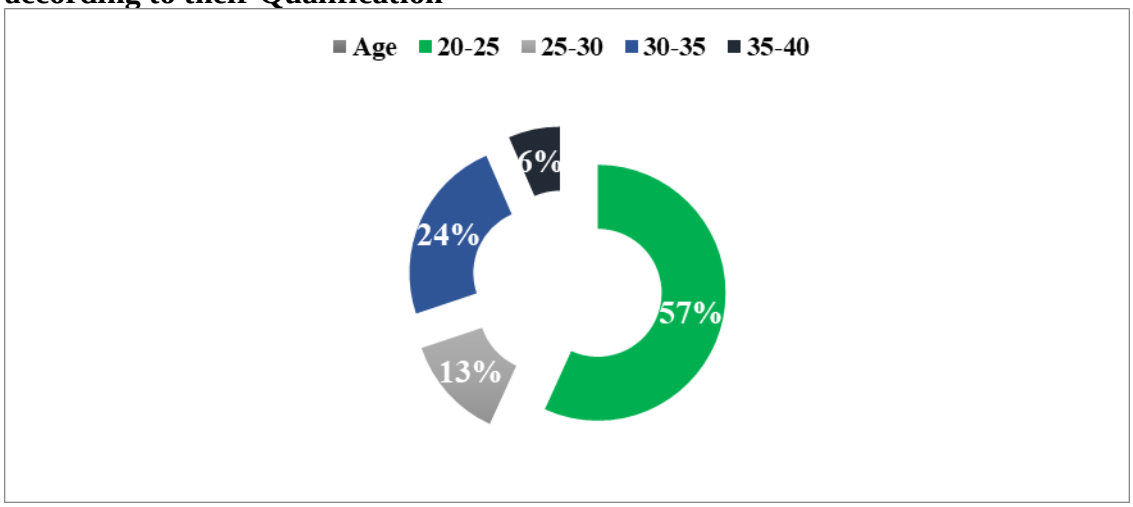
sl no	Demographic variables	Frequency (f)	Percentage %
1	**Gender**		
	a) Male	92	46.23%
	b) Female	107	53.76%
2	**Qualification**		
	a) Nurses	41	20.60%
	b) Doctors	48	24.12%
	c) Technicians	9	4.52%
	d) Radiologists	5	2.51%
	e) Nursing students	40	20.10%
	f) Medical students	56	28.14%
3	**Age**		
	20-25	113	56.78%
	26-30	26	13.06%
	31-35	47	23.61%
	36-40	13	6.53%



Graph 1: Pie graph showing distribution of healthcare workers according to Gender



Graph 2: Bar Graph showing percentage distribution of Healthcare Workers according to their Qualification



Graph 3: Doughnut graph showing percentage distribution of Healthcare workers according to their Age

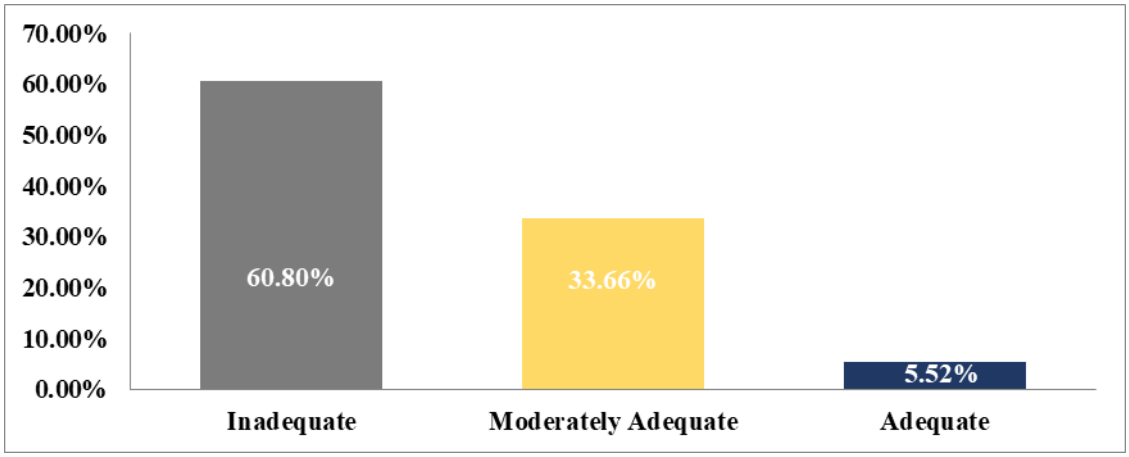
Section 2: Frequency and percentage distribution of level of knowledge of respondents

Table no 3: Frequency and percentage distribution of level of knowledge of the respondents

Level of knowledge		
Level of knowledge	**Frequency**	**Percentage (%)**
Inadequate	**121**	**60.80%**
Moderately Adequate	**67**	**33.66%**
Adequate	**11**	**5.52%**

Data in the table no 2 shows that out of 199 samples, Majority 121 (60.80%) had inadequate knowledge, 67 (33.66%) had moderately adequate knowledge and 11 (5.52%) had adequate knowledge regarding Artificial intelligence in healthcare

Graph 4: Columnar graph showing level of knowledge of the respondents



From graph 4, it was observed that there were only 5.52% of respondents who had adequate knowledge regarding Artificial intelligence in healthcare.

Section 3: Frequency & Percentage distribution of level of Attitude of respondents

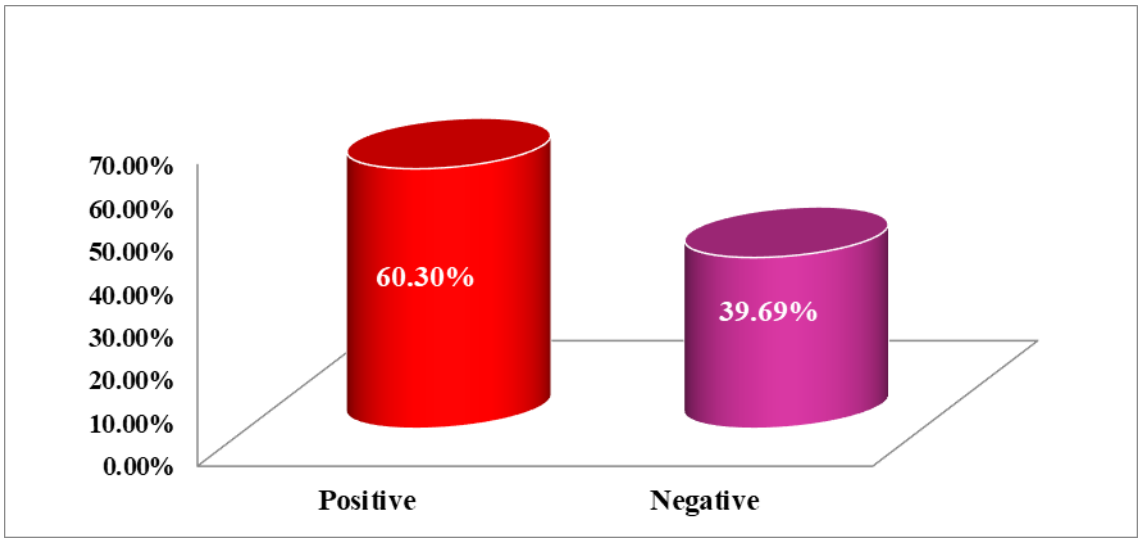
Table no 4: Frequency and Percentage distribution of level of Attitude of respondents.

Level of Attitude		
Level of Attitude	**Frequency**	**Percentage**
Positive	**120**	**60.30%**
Negative	**79**	**39.69%**

Total	**199**	**100.0%**

Data in table no 3 shows that majority of samples 120 (60.30%) had positive attitude and 79 (39.69%) had negative attitude towards Artificial intelligence in healthcare

Graph no 5: Cylindrical graph showing level of Attitude of respondents.



From Graph 5: it was observed that majority of the respondents 60.30% had positive attitude towards the Artificial intelligence in Healthcare.

Section 4: Analysis and interpretation of data to find out correlation between knowledge score and attitude score.

Table no 5: Correlation between knowledge score and attitude score

Knowledge V/s Attitude	∑X	∑Y	SD of X	SD of Y	Karl Pearson's coefficient of correlation (rxy)
	7046	1103	2.7037	2.8495	0.0041392 Positively correlated

Table no 4 reveals that there is a positive correlation between knowledge scores and attitude scores of the healthcare workers

Section 5: Association between knowledge score and their selected demographic variables

Table no 6: Association between knowledge score and their selected demographic variables

Demographic variables	Median <5	Median >5	X^2_{cal}	X^2_{tab}	df	remarks
Gender						
a. Male	**32**	**60**	11.05	3.841	1	**Not satisfied**
b. Female	**48**	**59**				
Qualification						
a. Nurses	**16**	**25**				
b. Doctors	**26**	**22**				
c. Technicians	**2**	**7**	8.0447	11.07	5	**Not satisfied**
d. Radiologists	**2**	**3**				
e. Nursing students	**14**	**26**				
f. Medical students	**24**	**32**				
Age						
a. 0-25	**35**	**78**				
b. 6-30	**16**	**10**	13.791	7.815	3	**Not satisfied**
c. 1-35	**17**	**30**				
d. 6-40 yrs	**9**	**4**				

The table no 5 shows that

- The calculated chi square value for the association between gender and the attitude shows that the calculated chi square value (11.05) is greater than the tabulated chi square value (3.841), hence rejecting the Null hypothesis [H0] and accepting the alternate hypothesis [H1]

Ho: There is no Association between the Gender and the attitude regarding Artificial intelligence among healthcare workers.
H1: There is Association between the Gender and the attitude regarding Artificial intelligence among healthcare workers.
The calculated chi square value for the association between Qualification and the attitude shows that the calculated chi square value (8.0447) is lesser than the tabulated chi square value (11.07), hence accepting the Null hypothesis [H0] and rejecting the alternate hypothesis [H2]
Ho: There is no Association between the Qualification and the attitude regarding Artificial intelligence among healthcare workers.
H2: There is Association between the Qualification and the attitude regarding Artificial intelligence among healthcare workers.
The calculated chi square value for the association between Age and the attitude shows that the calculated chi square value (13.791) is greater than the tabulated chi square value (7.815), hence rejecting the Null hypothesis [H0] and accepting the alternate hypothesis [H3]
Ho: There is no Association between the Age and the attitude regarding Artificial intelligence among healthcare workers.
H3: There is Association between the Age and the attitude regarding Artificial intelligence among healthcare workers.

Table no 6: Association between Attitude and their selected demographic variable.

Table no 7: Association between knowledge score and their selected demographic variables

Demographic variables	Median <35	Median >35	X^2_{cal}	X^2_{tab}	df	Remarks
Gender						
c. Male	**40**	**52**	**0.039**	**3.841**	**1**	Significant
d. Female	**45**	**62**				
Qualification						
g. Nurses	**11**	**30**				
h. Doctors	**28**	**20**				
i. Technicians	**3**	**6**	**14.737**	**11.07**	**5**	Not satisfied
j. Radiologists	**0**	**5**				
k. Nursing students	**14**	**26**				
l. Medical students	**27**	**29**				

Age						
e. 0-25	**28**	**85**				
f. 6-30	**20**	**6**	**28**	**7.**		Not
g. 1-35	**11**	**36**	**.5**	**8**	**3**	satisf
h. 6-40 yrs	**5**	**8**	**88**	**1**		ied
				5		

The table no 6 shows that

The calculated chi square value for the association between gender and the knowledge shows that the calculated chi square value (0.039) is less than the tabulated chi square value (3.841), hence accepting the Null hypothesis [H0] and rejecting the alternate hypothesis [H4]

Ho: There is no Association between the Gender and the knowledge regarding Artificial intelligence among healthcare workers.

H4: There is Association between the Gender and the knowledge regarding Artificial intelligence among healthcare workers.

The calculated chi square value for the Association between Qualification and the level of knowledge shows that the calculated chi square value (14.737) is greater than the tabulated value (11.07) hence rejecting the null hypothesis [H0] and accepting the alternate hypothesis [H5]

H0: There is no association between the Qualification and the knowledge regarding Artificial intelligence among healthcare workers.

H5: There is Association between the Qualification and knowledge regarding Artificial intelligence among healthcare workers.

The calculated chi square value for the Association between age and the level of knowledge shows that the calculated chi square value (28.588) is greater than the tabulated value (7.815) hence rejecting the null hypothesis [H0] and accepting the alternate hypothesis [H6]

H0: There is no association between the Age and the knowledge regarding Artificial intelligence among healthcare workers.

H6: There is Association between the Age and knowledge regarding Artificial intelligence among healthcare workers

Major findings of the study were:

In the present study it was found that out of 199 healthcare workers, majority of them 113(56.78%) belonged to the age group of 20-25 years of age while 26(13.06%) belonged to the age group of 26-30, 47(23.61%) belonged to the age group of 31-35 and 13(6.53%) belonged to the age group of 36-40 years of age. In terms of gender the majority 107(53.76%) were Females and 92(46.23%) were Males. Majority of the subjects 56(28.14%) had the educational qualification of medical students, 48(24.12%) holds the qualification as Doctors, 41 (20.60%) were Nurses, 40 (20.10%) were Nursing students, 09(4.52%) were Technicians and 05 (2.51%) were Radiologists.

Assessing the level of Knowledge: Out of 119 healthcare workers, 121(60.80%) had inadequate level of knowledge and 67(33.66%) had moderately adequate knowledge and 11 (5.52%) of them had adequate knowledge regarding Artificial intelligence in healthcare

Correlation between knowledge and attitude score:

The data analysis was done for the correlation between knowledge and attitude score using Karl Pearson's coefficient of correlation formula. The findings rxy=0.0041392 since 0< rxy < 1, hence there is a positive correlation between knowledge and attitude scores

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