



# Integration of Artificial Intelligence and Human Computer Interaction in Healthcare

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**Abstract:** Artificial intelligence (AI) and human-computer interaction (HCI) are two important fields that are increasingly being used in the healthcare industry. AI technologies such as machine learning and natural language processing can be used to analyze large amounts of data, identify patterns and trends, and make predictions. This can be helpful in a variety of healthcare applications, such as predicting the likelihood of a patient developing a particular disease or condition, helping doctors diagnose patients more accurately, and identifying potential side effects of drugs. HCI, on the other hand, focuses on the design of user-friendly and effective interfaces between humans and computers. In healthcare, HCI plays a crucial role in the development of electronic health record systems, telemedicine platforms, and other digital health tools that allow healthcare professionals to more easily access and manage patient data. AI alone cannot provide the insights that healthcare providers need without effective HCI to enable interpretation and action, while HCI alone cannot provide the level of accuracy and efficiency that AI can deliver. By using AI and HCI together, healthcare providers can leverage the strengths of both technologies, allowing for more efficient and accurate analysis of data, improved diagnosis and treatment, and ultimately, better patient outcomes. Overall, the future of AI and HCI in healthcare looks bright, and these technologies have the potential to greatly improve the way that healthcare is delivered and to make it more accessible and affordable for people around the world.

**Keywords:** artificial intelligence, human-computer interaction, healthcare, usability, machine learning.

## I. INTRODUCTION

For interaction in the modern world, digital tools are now widely used. All fields and sectors now depend heavily on computing, which has become a part of everything. Mobile computing has emerged as one of the key trends of the modern era among all technological technologies [1]. Medical practice is being transformed over time by artificial intelligence (AI). Thanks to recent developments in digital data collection, machine learning, and computer infrastructure [2], AI applications are now being deployed in areas that were previously thought to be the unique purview of human expertise [3]. In this review article, we evaluate recent advances in AI technology and their biomedical applications, emphasize the challenges facing the continuing development of medical AI systems, and go through the implications of AI in healthcare for the economy, law, and society [4].

In recent years, AI technologies being integrated into healthcare systems to improve patient outcomes, reduce costs, and enhance the overall quality of care. One major area where AI is having an impact is medical imaging. AI algorithms can be used to analyze medical images, such as CT scans and X-rays, to identify anomalies and abnormalities that may be missed by human experts. This technology can help to speed up diagnosis and treatment, improving patient outcomes and reducing the risk of misdiagnosis. [5]. AI is also being used to develop predictive models that can help healthcare professionals identify patients who are at high risk of developing certain

conditions, such as heart disease or diabetes. By analyzing patient data, including medical history, lifestyle factors, and genetic information, AI algorithms can help identify patterns and risk factors that may not be immediately obvious to human experts. This can help health care professionals to intervene early, providing preventative care and reducing the risk of serious health complications. [6].

A paper by Guanqi Xie et al. (2020) "Artificial Intelligence and Human-Computer Interaction in Healthcare: A Review" reviews the current state of AI and HCI in healthcare and identifies the potential benefits and challenges of these technologies. The authors conclude that AI and HCI have the potential to improve patient outcomes, enhance the efficiency of healthcare delivery, and reduce costs, but that careful consideration must be given to issues of privacy, security, and ethical concerns. [7]. Another paper by Yali Pang et al. (2021) "Artificial Intelligence and Human-Computer Interaction in Healthcare: Opportunities and Challenges" examines the opportunities and challenges of AI and HCI in healthcare and explores the potential impact of these technologies on patient care, provider workflows, and healthcare systems. The authors identify several key challenges, including the need for standardized data, the development of ethical frameworks, and the need for effective collaboration between healthcare providers and AI developers [8]. Another paper by Mehdi Rezaei et al. (2021) "Artificial Intelligence in Healthcare: Past, Present, and Future" provides an overview of the history and current state of AI in healthcare and explores the potential impact of these technologies on healthcare delivery in the future. The authors

identify several key challenges, including the need for standardized data, the development of ethical guidelines, and the need for effective collaboration between healthcare providers and AI developers [9].

## II. METHODOLOGY OF RESEARCH

The study design, a group of research articles that have been examined in the literature, and new data sources and justification standards will all be expanded upon in this part.

### A. Research Questions

In this study, the following research issues are addressed:

1. How AI assist HCI in healthcare?
2. How are AI modern technologies useful for HCI in the healthcare system?
3. What are the obstacles that AI and HCI in healthcare face, and how may they be overcome?
4. What role will AI and HCI play in healthcare in the future?

Below, we provide useful information gleaned from studies on HCI and AI that addresses the problems raised above. Below is a description of the responses:

#### 1. How AI assist HCI in healthcare?

The term "human-computer interaction" (HCI) in healthcare refers to how people and computers interact in a healthcare setting. This encompasses how computer systems, equipment, and software are created and used in healthcare settings, as well as how these technologies assist the provision of healthcare services [10].

Healthcare HCI can take many different forms, such as:

- Computerized systems known as electronic health records (EHRs) are used to store patient medical data such as diagnoses, prescriptions, and test results. EHRs are frequently utilized to increase the precision and effectiveness of healthcare delivery.
- Devices used to diagnose, track, or treat medical disorders are referred to as medical devices. Pacemakers, insulin pumps, and vital sign monitors are a few examples.
- Clinical decision support systems are computer-based tools that give healthcare professionals advice and information to use in making decisions on patient care.
- Telemedicine is the practice of providing medical treatment remotely using tools like video conferencing. Patients in underserved or remote places may have easier access to care thanks to telemedicine.

On the other hand, Artificial intelligence (AI) has the potential to completely change the healthcare sector by enhancing patient care, lowering costs, and boosting productivity. Some ways that AI is being used in healthcare include:

- AI may be used to evaluate medical pictures, such as X-rays and CT scans, and help with diagnosis in the field of medicine.
- Predictive analytics: Using AI, it is possible to find patterns in vast volumes of data, including electronic health records, and forecast results. This can assist medical professionals in making better judgments and enhancing patient care.
- AI may examine genetic data and make individualized therapy suggestions for specific individuals as part of personalized medicine.
- Drug research and discovery: Artificial intelligence (AI) may be used to quickly find possible new medications by analyzing vast volumes of data.
- Virtual assistants: Chatbots, for example, may be made using AI to serve as patients' virtual assistants and deliver information.

Overall, applying AI and HCI in healthcare can assist to increase the efficacy and efficiency of the healthcare system, resulting in improved patient outcomes and experiences [11].

#### 2. How are AI modern technologies useful for HCI in the healthcare system?

The technologies utilized in AI and HCI for healthcare span a wide spectrum, including:

1. Algorithms for machine learning are used to examine massive volumes of data and find patterns and trends that may be utilized to predict patient outcomes and enhance care.
2. Healthcare systems can comprehend patient comments and requests thanks to natural language processing (NLP) technology, which analyzes and interpret human language.
3. Healthcare professionals can access electronic health records (EHRs) to see and update patient data. EHRs are digital representations of patients' medical records.
4. Patients' vital signs and other health indicators may be monitored with wearable technology, such as fitness trackers and smartwatches.
5. Chatbots and virtual assistants are two technologies that can help patients manage their own treatment. For example, they can provide prescription reminders or respond to inquiries regarding dosage schedules.
6. Platforms for telemedicine allow patients to communicate with medical professionals at a distance, making it possible to offer consultations and other sorts of care remotely.

#### 3. What are the obstacles that AI and HCI in healthcare face, and how may they be overcome?

Using HCI and AI in healthcare can lead to a variety of problems. Healthcare systems deal with sensitive personal and medical data, thus it's critical to make sure that this data

is safeguarded and cannot be accessed by unauthorized parties [6]. The use of AI in healthcare raises a variety of ethical issues, including the possibility of biased decision-making and the distribution of scarce healthcare resources. Even if an AI or HCI system is dependable and functional, it will not be a success if it is not used by healthcare professionals and patients[1]. New AI and HCI systems might be difficult to integrate since many healthcare companies already use a variety of systems and technology. Healthcare companies may find it challenging to compare and choose the best technology due to the existing lack of standards in the application of AI and HCI[12]. In order to maximize the advantages and reduce any potential hazards or difficulties, it is crucial to carefully address these and other concerns when using AI and HCI in healthcare.

4. What role will AI and HCI play in healthcare in the future?

As they can increase the efficacy and efficiency of the healthcare system, AI and HCI are anticipated to become more significant in the future of healthcare. Machine learning algorithms can analyze vast volumes of data to find patterns and trends that may be used to forecast patient outcomes and enhance care. In order to avoid or manage specific illnesses, this can be used to identify those who are at risk for them and take early action. Health care practitioners can better understand patient’s wants and preferences by using natural language processing (NLP) tools to evaluate and interpret patient comments and requests. This has the potential to raise both patient happiness and overall treatment quality.

Future trends in telemedicine predict a rise in the use of technology like video conferencing and remote monitoring. By enabling patients to get care remotely, this can assist to increase access to care for people in underserved or rural regions and can also help to lessen the strain on healthcare systems. Using AI and HCI, medical treatments may be tailored to a patient's particular traits, such as genetics and health history. This can lessen the possibility of negative responses and improve treatment results.

Overall, AI and HCI are anticipated to have a substantial impact on how healthcare is provided in the future and are likely to be included in a variety of healthcare technologies and systems.

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**B. Criteria**

HCI and AI have been examined in the past by renowned scholars. Human-Computer Interaction, Usability, HCI in

Healthcare, Artificial Intelligence, AI, and AI In Healthcare were the search strings chosen to conduct the literature study for this work.

**C. Data Sources**

The literature was looked up using several different data sources. Figure 1 displays the proportion of publications that were obtained from each data source.

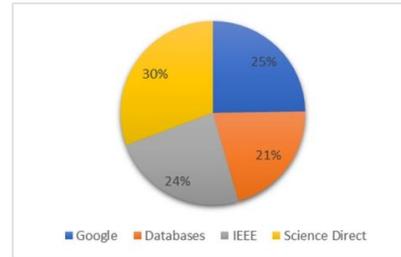


Figure 1. Percentage of papers include

**D. Exploration Criteria**

Between 2021 and 2023, research was conducted for this paper. The work that was investigated was initially assessed using the inclusion criteria and keywords.

**E. Exclusion and Inclusion Criteria**

Exclusion and inclusion criteria are crucial because they ensure that the research population is clear-cut and accurate in its representation of the target population. Figure 2 displays the total number of articles that were reviewed for this work, the papers that were included, and the number of papers that were reviewed in each domain.

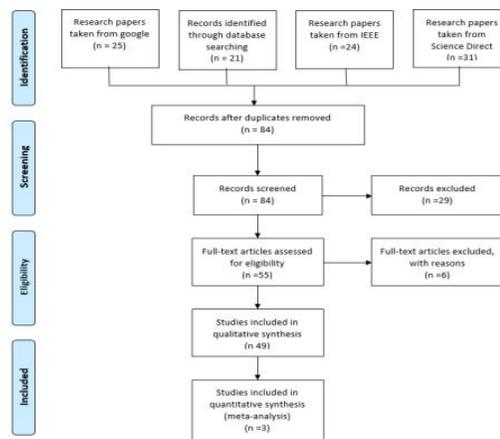


Figure 2. Prisma model of paper included and excluded

**F. Quality Assessment Criteria**

Following are the grades that are used for quality assessment criteria

Item	Description	Grade
1	<b>Title</b>	0 = inaccurate/not concise 1 = accurate and concise
2	<b>Abstract</b> Summary of the background, research objectives, including details of the species or strain of animal used, key methods, principal findings, and conclusions of the study	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
3	<b>Introduction</b> Background-objectives, experimental approach, and rationale, relevance to human biology	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
4	<b>Introduction</b> Objectives-primary and secondary	0 = not clear 1 = clear
5	<b>Methods</b> Ethical statement-nature of the review permission, relevant licenses, national and institutional guidelines for the care and use of animals	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
6	<b>Methods</b> Study design-number of experimental and control groups, any steps are taken to minimize bias (i.e., allocation concealment, randomization, blinding)	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
7	<b>Methods</b> Experimental procedure-precise details (i.e., how, when, where why)	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
8	<b>Methods</b> Experimental animals-species, strain, sex, developmental stage, weight, source of animals	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate
9	<b>Methods</b> Housing and husbandry-conditions and welfare-related assessment interventions (i.e., type of cage, bedding material, number of cages)	0 = clearly inaccurate 1 = less accurate 2 = clearly accurate

Figure 3. Quality assessment criteria

G. Quality Assessment Criteria Results

Following are the results after grading

References	Items									
Nazar, Mobeen, et al (2021)	1	1	2	2	1	2	2	2	2	15
Rundo, Leonardo, et al (2022)	2	0	1	2	1	0	2	1	2	11
Inkpen, Kori, et al.(2021)	1	2	1	1	1	2	1	1	1	11
Chancellor, S.(2023)	2	1	2	2	2	1	2	2	2	16
De Choudhury (2021)	2	2	1	2	1	2	2	1	2	15
Veale, M. and Bommer, E.P.(2021)	1	2	2	1	2	2	1	2	1	14
Ontika, Nazmun Nisat (2022)	2	2	2	2	2	2	2	2	2	18
Hussain Abid Syed (2022)	2	2	0	2	0	2	2	0	2	12
Shereea May Saftmannshausen (2021)	2	1	2	2	2	1	2	2	2	16
Richard Hr harper et al. (2022)	2	0	1	2	1	0	2	1	2	11
Masuda, Y., Ishii, R., Shepard (2022)	1	2	0	1	0	2	1	0	1	8
Jain, R., Nakamura, O. (2022)	2	2	2	2	2	2	2	2	2	18
Osmann Andersen, T., Nunes(2021)	2	2	1	2	1	2	2	1	2	15
Wilcox, L., Kazimmas(2021)	1	0	0	1	0	0	1	0	1	4
Matthiesen, S. and Magrabi, F.(2022)	2	1	2	2	2	1	2	2	2	16
Breuer, S., Braum (2022)	1	2	1	1	1	2	1	1	1	11
	26	22	20	27	19	23	27	20	27	

Figure 4. Quality assessment criteria results

H. Heatmap

Following is the heatmap for the above quality assessment criteria

References	Items									
Nazar, Mobeen, et al (2021)	1	1	2	2	1	2	2	2	2	15
Rundo, Leonardo, et al (2022)	2	0	1	2	1	0	2	1	2	11
Inkpen, Kori, et al.(2021)	1	2	1	1	1	2	1	1	1	11
Chancellor, S.(2023)	2	1	2	2	2	1	2	2	2	16
De Choudhury (2021)	2	2	1	2	1	2	2	1	2	15
Veale, M. and Bommer, E.P.(2021)	1	2	2	1	2	2	1	2	1	14
Ontika, Nazmun Nisat (2022)	2	2	2	2	2	2	2	2	2	18
Hussain Abid Syed (2022)	2	2	0	2	0	2	2	0	2	12
Shereea May Saftmannshausen (2021)	2	1	2	2	2	1	2	2	2	16
Richard Hr harper et al. (2022)	2	0	1	2	1	0	2	1	2	11
Masuda, Y., Ishii, R., Shepard (2022)	1	2	0	1	0	2	1	0	1	8
Jain, R., Nakamura, O. (2022)	2	2	2	2	2	2	2	2	2	18
Osmann Andersen, T., Nunes(2021)	2	2	1	2	1	2	2	1	2	15
Wilcox, L., Kazimmas(2021)	1	0	0	1	0	0	1	0	1	4
Matthiesen, S. and Magrabi, F.(2022)	2	1	2	2	2	1	2	2	2	16
Breuer, S., Braum (2022)	1	2	1	1	1	2	1	1	1	11
	26	22	20	27	19	23	27	20	27	

Figure 5.Heatmap results

III. BACKGROUND OF RESEARCH

In terms of the domains in which they are employed, HCI and AI will be discussed in this section. The fundamentals of

HCI will be covered in this part first, followed by a discussion of AI and its associated topics.

A. Human Computer Interaction

In order to make computer technology more useful and effective for humans, the field of research known as human-computer interaction (HCI) concentrates on how to design and utilize computers[13]. It requires comprehending how people use computers and knowing how to create user-friendly systems and user interfaces that cater to their demands. Computer science, psychology, sociology, and other disciplines are all included in the multidisciplinary study of HCI[14]. It is significant because by creating user-friendly systems that cater to their users' requirements, it makes technology more usable and accessible to everyone[15].

Human-computer interaction (HCI) covers a wide range of problems related to the design and use of computer systems some are:

- How to create user interfaces that are simple, effective, and rewarding for the users.
- Designing systems with the requirements and objectives of the users in mind (user-centered design).
- How to create software that is user-friendly for those with impairments.
- The numerous methods that individuals may interact with computer systems, such as through keyboard and mouse input, touch displays, or voice instructions, are known as interaction strategies.
- How to create effective, user-friendly visual representations of data and information.
- How to create systems that encourage cooperation and teamwork using collaborative computing.

Figure 6. provides a full explanation of HCI and its disciplines, as well as each of its subfields and the functions that each subfield is intended to serve. The goal of HCI is to make humans and computer devices interact better[16].

1. Usability

Usability is a crucial component of HCI. An important aspect of a computer system's success is how simple it is for a user to understand and utilize it[17]. A system that is well-designed can be more productive, efficient, and enjoyable to use, whereas one that is poorly designed can frustrate users and reduce efficiency[18]. Several techniques may be used to assess usability, including usability testing, in which users are watched while they interact with a system, and heuristic assessments, in which a system is assessed in relation to a set of usability principles[19]. Effectiveness, efficiency, and satisfaction are some of the elements that need to be emphasized about the usability metrics[20].

a) Effectiveness

The degree to which a computer system aids users in achieving their objectives and carrying out activities is

referred to as effectiveness in HCI. An efficient system may carry out the tasks for which it was created in a way that satisfies the requirements of its users[21].

*b) Efficiency*

In human-computer interaction (HCI), efficiency refers to how quickly a person can complete activities with the aid of a computer system. A system that is effective and pleasurable to use enables users to execute activities quickly and with the least amount of effort[21].

*c) Satisfaction*

The level of user satisfaction with a computer system is referred to as human-computer interaction (HCI) satisfaction. A system that fulfills consumers' requirements and expectations while being fun to use[21].

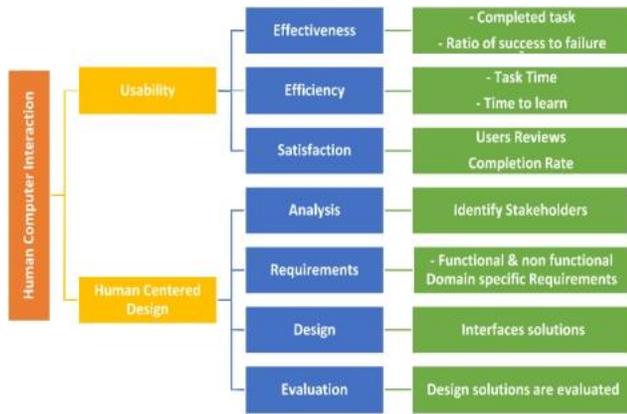


Figure 6. Human Computer Interaction and its Sub-fields

**2. Human Centered Design**

A design strategy known as human-centered design (HCD) concentrates on the requirements, objectives, and preferences of the users of a system or product. Designing computer systems that are user-friendly, effective, and enjoyable is a key component of human-computer interaction (HCI)[22]. HCD aims to provide designs that are appealing to, helpful for, and useable by people. To make sure that the finished product satisfies their needs, an iterative approach that includes continuing testing and user input is used[23].

**B. Artificial Intelligence**

Artificial intelligence (AI) is the capacity of a computer or machine to carry out operations that ordinarily call for human-like intellect, such as learning, problem-solving, and decision-making[24]. A variety of activities, from straightforward ones like pattern recognition and prediction to more difficult ones like comprehending and producing human language, may be built into AI systems[25]. The use of AI in a wide range of applications, including speech and image recognition, language translation, and autonomous vehicles, has the potential to revolutionize several different

sectors. AI can address a variety of issues, including those that are challenging or impracticable for humans to address.

AI may be applied to solve a variety of issues, for instance:

- AI can analyze vast volumes of data and make decisions by seeing patterns and trends that may not be obvious to humans. This may be utilized to make better judgments in a range of industries, including marketing, finance, and healthcare.
- Predictive modeling: Using data from the past, AI may be used to anticipate future occurrences or results. This is useful for trend forecasting, resource optimization, and better decision-making.
- Allocating resources and optimizing processes: AI can be used to do this in a way that maximizes effectiveness and cuts down on waste.
- Automation: AI may be used to automate time-consuming or repetitive operations, freeing up people to concentrate on more difficult or creative jobs.
- Artificial intelligence (AI) may be used to comprehend and produce human language, making it possible to perform functions like voice recognition and language translation.

AI can address a wide range of issues in a variety of disciplines, and as technology develops, so do its possibilities. The subfields of artificial intelligence and how they were further divided into additional subfields are briefly summarized in Figure 7. The following is a discussion of a few AI-related fields:

*a) Machine Learning*

Artificial intelligence (AI) in the form of machine learning involves teaching a computer to spot patterns in data and basing choices or predictions on those patterns. A computer may "learn" this manner without being expressly programmed. A computer is asked to predict or decide based on a collection of data (referred to as the training data) in machine learning. The information is then utilized to modify the algorithms that the computer employs to make judgements after receiving feedback on how accurate its predictions were [26]. The computer "learns" from the data over time and improves the accuracy of its predictions and judgements.

Machine learning can take a variety of forms, including [27]

- The computer is asked to generate predictions using a collection of labelled data, data that has been annotated with the right response in a process known as supervised learning.
- Unsupervised learning: In this kind of machine learning, the computer is given an unlabeled

collection of data and instructed to identify patterns and correlations.

- Reinforcement learning is a sort of machine learning in which the computer is given a series of actions to do and is rewarded or penalized in accordance with the results of those actions. By making mistakes and trying again, the computer "learns" which activities are most likely to succeed.

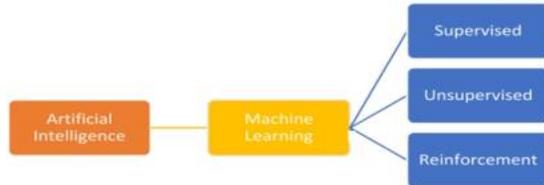


Figure 7. Human Computer Interaction and its Sub-fields

### C. Challenges integrating AI and HCI in healthcare

Integrating artificial intelligence (AI) with human-computer interaction (HCI) in the healthcare industry presents several difficulties. Making sure AI systems can make correct and dependable judgements is crucial for the healthcare industry since even little mistakes may have major repercussions. It can be difficult to guarantee the precision and dependability of these systems, especially when the complexity of the activities they are utilized for rises. The application of AI in healthcare frequently entails the gathering and analysis of significant volumes of delicate personal data [28]. To safeguard patients' privacy and to uphold confidence, it is crucial to guarantee the privacy and security of this data.

AI systems can display bias if they are trained on biased data or if they are intentionally created in a biased way. Certain groups of individuals may be treated unfairly because of this. In the healthcare industry, addressing bias in AI systems is a significant concern. Managing the integration of AI into healthcare workflows: AI has the potential to be a strong tool in the industry, but it has to be seamlessly and effectively incorporated into current workflows and procedures. This can be difficult since building AI systems that can function well within these restrictions requires a grasp of the requirements and constraints of healthcare personnel [29].

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### IV. LIMITATION OF THIS REVIEW

Less than half of the databases, journals, and conferences that were reviewed for the literature study were included. No items were mentioned prior to 2021. The literature could

only be searched using a certain number of strings and keywords. Finally, the research concentrated on the foundations of HCI and AI in healthcare as well as the issues that arise from them.

### V. CONCLUSION

In conclusion, the integration of artificial intelligence (AI) and human-computer interaction (HCI) in healthcare has the potential to revolutionize the way healthcare is delivered. AI algorithms can analyze vast amounts of patient data, identifying patterns and predicting outcomes, while HCI can be used to design user-friendly interfaces that enable healthcare providers to interpret and act on this data. The use of AI and HCI in medical imaging, predictive modeling, and personalized treatment planning has already demonstrated significant benefits, including improved accuracy, efficiency, and patient outcomes. However, there are also significant challenges to address, including ethical considerations, privacy and security concerns, and the need for standardized data. It is essential to ensure that these technologies are developed and implemented responsibly, with a focus on patient privacy, security, and ethical concerns. Ultimately, successful collaboration between healthcare providers and AI developers will be essential to maximize the potential benefits of AI and HCI in healthcare and transform the way healthcare is delivered.

### VI. FUTURE DIRECTIONS

The combination of artificial intelligence (AI) and human-computer interaction (HCI) in the healthcare industry has several potential future paths. In places where there is a dearth of qualified healthcare workers, AI systems may be utilized to help with diagnosis and treatment planning. AI systems may be able to scan medical photos, for instance, to spot patterns or anomalies that a human observer would miss. Personalized treatment plans may be developed using AI to assess patient data and find solutions that are suited to each patient's particular requirements and traits.

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