International Journal of Health Services Research and Policy
www.dergipark.org.tr/ijhsrp

IJHSRP

e-ISSN: 2602-3482

Review Article

USE OF ARTIFICIAL INTELLIGENCE IN HEALTH SERVICES MANAGEMENT IN TÜRKİYE

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Abstract: *With the inclusion of technological developments in the health sector, the importance given to artificial intelligence in the field of medicine is increasing. For the future, the application possibilities of artificial intelligence and especially the potential of big data are quite large. There are many uses for artificial intelligence applications in health services, such as surveillance systems, epidemiological analysis, detection of health risks, early diagnosis of diseases, epidemic management and vaccine studies. In addition, there are some potential positive and negative consequences of integrating artificial intelligence into modern medicine. The purpose of this review is to provide information about the concept of artificial intelligence and to evaluate the usage areas, potential benefits and aspects of artificial intelligence in Health Services from a perspective perspective through various application examples.*

Keywords*: Artificial intelligence, Artificial intelligence in healthcare, Artificial intelligence processes in healthcare*

Received: May 16, 2023 *Accepted: August 14, 2023*

1. Introduction

Health institutions are multidisciplinary Deconstructions where a large number of health professionals work together, and cooperation prevails. With the development of technology, it is observed that technology has started to take an important place in health services. Along with the stages that the industry has passed, industry 4.0 is being mentioned today. However, the emerging public is being used to understand this change in 5.0 [1]. In parallel with the developments in the industrial revolutions, the transformation process in health follows a similar process and this situation is expressed as health 4.0 today [2]. For this reason, it is thought that it is important to have information about the stages of the industry in order to understand the digital transformation in health institutions. In the first industrial revolution, that is, in Industry 1.0, mechanical production facilities were started to be established with the use of water and steam power [3]. In the second industrial revolution, i.e. industry 2.0, the use of electrical energy and the diversion of this energy to the assembly line attract attention [4]. In the third industrial revolution, that is, in Industry 3.0, programmable machines began to be used in production, and the use of computers and the Internet became widespread [5].

Finally, industry 4.0, also called the fourth industrial revolution, aims to meet expectations at the highest level with rapidly developing technology opportunities [6]. Due to these developments, both the patient and today the health 4.0 period, which provides health services with technologies to inform the physician, has also started to show development [7]. With Health 4.0, attention is paid to issues such as

virtualization, personalization in health services, and improvement in the health industry under the influence of technology [8]. Today, due to many remarkable conditions such as increasing population, epidemics, and chronic diseases, health services are looking for new ways. With the effect of digitalization, it is thought that one of these ways is through artificial intelligence applications [9].

Artificial intelligence: is stated as the transfer of human characteristics such as thinking, decision-making, speech, visual perception, and interpretation to systems such as robots and computers through programs [10,11]. As in every field, artificial intelligence applications in health services are being discussed and discussed more and more every day [12]. In the field of artificial intelligence, and health it is seen that it is used for administrative and clinical purposes. In its use for administrative purposes, health management, documentation management, efficient use of hospital capacity, reduction of errors and irregularities, and cost and quality management can be considered situations such as [13]. In its clinical use, early diagnosis and emergency intervention, test result tracking and early intervention, imaging analysis tools, robotic surgery with artificial intelligence support, personalized treatment, post-treatment clinical decision support, drug treatment tracking, and drug development, care for the patient at the last stage of life are focused on situations such as [12,13,14]. It is stated that with the introduction of artificial intelligence in the field of health, some advantages and disadvantages will be encountered. First of all, there is the idea that artificial intelligence will not meet people's expectations of understanding and being understood [15]. However, it is thought that human-caused errors will be prevented by using artificial intelligence in the health field [16]. Despite these advantages, healthcare professionals are concerned about artificial intelligence for many reasons [13]. Due to the increasing elderly population all over the world, many countries are investing in this area by attaching importance to health-related artificial intelligence technologies [17]. With this review, it has tried to clarify the point of view of health administrators on artificial intelligence. it was written in order to provide a perspective point of view about the content of artificial intelligence and to share information about its use in the field of health.

2. The Concept of Artificial Intelligence

The concept of intelligence has been explained by the Turkish Language Association as "the ability of people to comprehend the facts, reason, and draw conclusions" [18]. Artificial intelligence is the name of the intelligence developed by the machine as an alternative to this "natural" personal intelligence. The ability of the machine to analyze and draw conclusions from the information it obtains by absorbing its surroundings, similar to a person, is called artificial intelligence [19]. While human intelligence develops with training and experience, machines can also have intelligence due to appropriate "training" and sufficient "experience". The algorithm is described as the steps to follow in troubleshooting a problem. Artificial intelligence consists of highly complex algorithms based on lean conditional expression. In a lean algorithm, a condition is defined to the machine, and the steps are explained one by one, such as what to do when the relevant condition is fulfilled and not. Machine learning, on the other hand, is a subset of artificial intelligence and relies on patterns and inferences produced as a result of algorithms and models [20].

Here, all algorithms are not written one by one by the programmer. Instead, the machine is taught a "training" set of sample data and inferences, and the model is created, allowing the machine to make predictions. In deep learning, which is an advanced stage of machine learning, learning similar to the nervous system is aimed [21]. The machine is taught information in the form of layers, enabling it to analyze the relationships of the information and create its own algorithm in advanced cases. In this way, the machine produces its own solution even in cases not defined by the software developer. Thanks to deep learning, it is possible to obtain results such as face recognition, voice recognition, and medical image analysis. Artificial intelligence, as it can be understood from these definitions, has a very

advanced learning ability and enables the computer to learn without the need for explicit coding through automatic extraction and analysis of complex data [22].

The computer learns from its mistakes and constantly improves. Moreover, if the appropriate data is provided, he/she can reach the ability to test the new knowledge he has acquired, to follow the success rate on his own, and to correct himself, if necessary, by forgetting the information he has learned. The biggest hesitations about the use of artificial intelligence in medicine are that the physician will take the decision-making stage and it cannot replace the human at this stage. However, as with other technological developments, the purpose of artificial intelligence is not to decide for the physician, but to support the physician in the decision-making process [23].

3. Artificial Intelligence Applications in Medicine

In the last 10 years, the number of studies on artificial intelligence in the field of medicine has increased considerably. Today, with cheaper storage possibilities and the increase in processing power, computers have the opportunity to reach the experience that a physician can gain throughout his life in seconds. Breast scanning is one of the main applications of artificial intelligence in radiological imaging. Due to the dense tissue of the breast, radiology reports prepared on mammogram results may differ and often require reinterpretation of images [24]. Artificial intelligence applications are preferred in the lesion category; It is based on making assumptions on pixels at the stage of distinguishing a tumor from normal tissue, malignant and benign lesions. With the image processing method, it is determined which pixels are normal parts of the relevant structure and which pixels are abnormal. Apart from breast imaging, there are systems that use automatic analysis algorithms in radiological acute ischemic imaging [25]. These systems help to detect thromboembolic vascular occlusions, infarct core, and potential infarct tissues at risk by evaluating computerized tomography and magnetic resonance imaging data together. As another imaging application, there are examples of the use of artificial intelligence with a success rate of 96% in the diagnosis of glaucoma [26]. Khorrami and his team conducted a study to utilize artificial intelligence applications to predict the response of non-small cell lung cancer patients to immunotherapy [27].

In the analysis performed on patient data in a retrospective approach, the differences in the CT models of tumor nodules before and after 2-3 cycles of treatment with machine learning were compared. The results suggest that the system can be used to explain patients' responses in the early stages of treatment. Tobacco et al. The WeCureX project, developed by WeCureX, is an artificial intelligence assistant application that aims to analyze and diagnose mental disorders through the answers given by the clients to the questions [28]. The application was created by training on the psychometric data of the patients and the diagnoses and evaluations of the patients. In the study, it was reported that the artificial intelligence assistant could reach the diagnosis with 97% accuracy over the data obtained. In the diagnosis of Alzheimer's, a mobile system has been developed that can make a successful diagnosis of more than 80% as a result of people drawing a clock on a digital screen and evaluating the drawings with artificial intelligence [29]. There are studies on artificial intelligence assistants that compete with dermatologists to diagnose nevus and are very successful [30]. Artificial intelligence applications are being developed in many areas such as systems that remind geriatric patients of medication hours, detection of Down syndrome through face images, and psychiatric diagnosis by semantic analysis method by transcribing speech into text. All these are just a few of the promising examples of artificial intelligence applications in the field of medicine, and they also make important contributions to issues such as genetic research, drug studies, and antibiotic resistance.

4. The Place of Artificial Intelligence in Healthcare Management

It is seen that artificial intelligence applications are needed to remove the conditions and negativities in the supply and management of health services, to bring the quality of health services to a better position, and to gain efficiency. These conditions are shown in the following headings [31].

4.1. 65^{+} Age Population Growth Condition in The World

The gradual increase in the number of people requires the operation of health care processes that require long-term treatment and care for the increasing 65+ age population. OECD data shows that the proportion of the 65+ age population in Finland in 2017 increased by 6.1% compared to 2000. Again in 2017, the total population ratio of 65+ increasing population in Turkey increased by 2.9% compared to 2000 [32]. According to OECD rates, it is understood that the population is aging both in Turkey and in the world. It is stated that TUIK's Life Tables increased 78.6 times between 2013 and 2015 [33]. According to 2017 OECD rates, there are 187 physicians per 100 thousand people in Turkey [34].In India, which has a population rate of 1.4 billion according to 2017 OECD rates, there are 78 physicians per 100 thousand people [32]. 6 is planned to be 25.6 by 2080 [32].

4.2. Condition of Diseases That Pose a Health Threat

In the report published by the World Health Organization (WHO) in 2019, 10 major health threats that could threaten human health worldwide were announced. In the report announced, air pollution, and viruses, which have increased with the growth of industry and technology, cause diseases to spread to the public due to inefficient health care services. The COVID-19 outbreak is an important public health problem that is being tackled all over the world. In addition, health problems increase due to insufficient drinking water and food due to socio-economic and cultural reasons. In the continuation of the report, heart diseases, cancer, diabetes, etc. It is stated that chronic diseases that are not contagious cause more than 70% of the losses in the world [35].

4.3. Low Standard of Living Quality Condition

One of the conditions that threaten people's health and cause them to be exposed to diseases is a low standard of living. In particular, the cause of death between the ages of 30-69 worldwide, consumption of cigarettes and alcoholic beverages is increasing. In addition, unhealthy diet, physical inactivity, and air pollution can cause [35]. In countries with low socio-economic conditions, access to food, drinking water, and hygiene products is limited due to low purchasing power or wars. To summarize briefly, responding to the increasing demand for health services challenges the health systems of countries.

4.4. Rise of Costs and Competition Condition

The prolongation of the average life expectancy of people over the age of 65 over the world causes high costs for long-term treatment processes. Implementing the current health policies of each country has become relatively difficult in the global world. One of the main reasons for this; is that unforeseen pandemics cause a large number of individuals to become ill and increase the demand for healthcare services. Health institutions with limited employment and capacity may be insufficient to meet the demand. In particular, vaccines and drugs required for treatment and protection studies require very high costs and a long time [36].

State and private hospitals that provide health services have to provide health services above a certain service quality. In order for health institutions to continue their existence as a business, they must have differences and superiorities in demand from their competitors. In such a case, it is inevitable to

benefit from artificial intelligence technologies as well as limited manpower despite the increasing number of patients [36].

4.5. Innovations in Informatics Technologies

As the internet develops and renews itself day by day, there is a digital transformation in the health sector as in many sectors. started to be preferred. One of the most crucial application areas of informatics technologies in health is artificial intelligence applications [37].

5. Applications of Artificial Intelligence In Healthcare Management

5.1. Uses of Artificial Intelligence for Management Purposes

- *General health process:* MHRS utilization rates, E-Pulse, etc. Applications to the hospital can be predicted using data, the length of stay and waiting times in the emergency services can be reduced, and ambulance access times can be standardized. Vaccines for babies can be followed and monitored.
- *Documentation process:* In electronic health record systems, health professionals' information can be rearranged, stored, and used. With Natural Language Development (DDG) tools, voice recordings and reports of physicians and healthcare professionals can be printed in a very short time with artificial intelligence-based processes.
- *Quality process:* Health institutions should not see the patient as a customer, unlike other procedures, while providing health services. In order for the health institution to maintain its currency, it must reduce the cost to be incurred and increase the quality of the service it provides. The Centerstone Research Institute has shown in a study that it is cheaper to diagnose using artificial intelligence than to reach a conventional conclusion. In this study, the results of the physical performances and conditions of 500 patients, who were named aimlessly, were compared with the decision-making models according to the artificial intelligence algorithm. As a result, it was revealed that there is a significant difference between the costs per unit.
- *Rational use of the capacity of health institutions:* It can be used for the possibility of rehabilitating the discharged patients as well as taking the empty bed capacity under instant control. Especially the increase in the number of patients in emergency services and the increase in the demand for these services recently necessitated the pre-calculation of the density. In one study, an application was designed by using the Long Short-Term Memory (LSTM) deep learning model, measuring the time-related emergency department density and calculating the number of patients per day for the following days and months. It may benefit the business in terms of the effective use of a limited number of beds in pandemics such as COVID-19.
- *Troubleshooting health services management:* It can be used to solve problems caused by reasons such as problems in archiving patient records and cyber-attacks. In the world, data related to health-related inputs, and applications used by people on the devices they carry, are designed as electronic health. Analyzing, archiving, and using big data created by health data requires finance and human effort. The Montefiore Health System in the USA, in collaboration with Intel, incorporated AI results and analysis to see common patterns in large amounts of patient data to more effectively serve a diverse patient population [37]. For this reason, it is possible to reduce the problems caused by the person, prevent the waste of medicine due to miscalculations due to drug doses, and prevent the damage caused by the wrong medical treatment applied to the patient.

6. Clinical Uses of Artificial Intelligence

- *Public Health Process:* Artificial intelligence applications can be used in subjects such as the application and evaluation of screening tests by reaching a large number of target audiences. Due to the COVID-19 epidemic, artificial intelligence applications are preferred today to protect people from risky areas and to predict their current health status without going to the hospital. During the COVID-19 epidemic, the data in the area where the application was made with the Filiation and Isolation Shading System (FITAS) were instantly lost to the system and used for rapid analysis. The spread plan for the first COVID-19 outbreak in Turkey was prepared. With the measures taken in line with the data obtained with FİTAS, it is aimed to reduce the rate of increase in the number of patients. [38].
- *Early diagnosis and emergency intervention process:* Especially in cancer cases, early diagnosis and treatment are very important. It is lifesaving to diagnose the complaint at the initial stage, without the need for visible symptoms. Parkinson's is a disease for which early diagnosis is important. In a prepared study, EEG (Electro moment cephalogram) signals, picture simulations, PDC (Partially directed coherence) data were categorized as sick people, drug addicts, and healthy individuals using machine learning skills. In the tests in the study, 99% of the real data were determined [39]. One of the generally known artificial intelligence support systems in the world is IBM Watson. With machine development and natural language processing capabilities, this system is designed to assist physicians in reviewing patients' electronic health records and reviewing search-related medical discovery publications and guidelines.
- *Interpretation of radiology images:* It is a very long process for the detailed viewing, interpretation, reporting, and evaluation of the report by the patient's physician. By choosing artificial intelligence applications, transferring images of physicians in patients with different nodules-lesions in radiology images can save both time and workload. In this way, a quality health service can be delivered in order to give the patient a timely opinion. In a study on the use of artificial intelligence applications in the field of radiology, Convolutional Neural Networks (ESA) were used for bone age estimation. As a result of the study, age evaluations of pediatric hand radiographs with ESA, evaluations of radiologists, and results were similar to the evaluations of radiologists [40].
- *The results:* It is extremely important to follow up the disease due to factors such as the recurrence of many diseases or the cause of another disease. By dressing the patient with artificial intelligence-based mobile devices, the patient can be followed by the physician wherever they are in the world. Since the test results given by the patient are recorded in the automation with the patient's permission, the physician can access and interpret the patient's results without reserving a place and time.
- *Treatment:* Clinical support systems primarily focus on complaint-oriented treatment algorithms, taking into account the symptoms and demographic information of the patients. The system has been used to identify bacteria that cause important infections and for antibiotics that can treat these infections [41]. In surgical operations, which is one of the treatment forms of patients, robots are used because of their benefits such as eliminating three-dimensional imaging vibration, facilitating access to organs, tissues, and nerves, and providing an ergonomic position to the surgeon. [42]. Together with the developments in artificial intelligence, the world's first and only robotic surgery system, the "Cyber Knife" has been developed. This robotic system performs the treatment with high-cure radiation, by looking at the tumor from different angles,

without the need for open surgery, without bleeding and pain, with an intervention that does not harm healthy tissues and cells [43].

- *Treatment process:* It provides support to the physician by predicting with artificial intelligence-based systems what kind of benefit and harm will be provided to the patient in the formation of possible treatment protocols or which protocol is preferred. The treatments of breast cancer patients by oncologists at a cancer center in India were compared in a retrospective observational study, using artificial intelligence applications called "Watson for Oncology". In general, the system showed a similarity of 93% (80% - 97%) according to cancer stage and age [44]. In another study, data on congenital cataracts were obtained from many hospitals. With the artificial intelligence-based system, it was determined that the framework showed 98.25% accuracy in the identification network and 92.86% accuracy in the treatment recommendations [45]. Different uses occur in artificial intelligence ophthalmology that can serve the purpose of providing excellent care [46].
- *Personalized treatment process:* Traditional treatment methods are insufficient to treat some diseases. Due to differences such as hereditary structure, immune system, and lifestyles, personalized treatment modalities need to be developed. Artificial intelligence applications are used in the development of personalized treatment methods. In a study conducted in Korea using the Technology Acceptance Model (TAM), a robot that provides home care services is recommended by taking into account parameters such as patients' behaviors, what they like, the number of people they live with, and their lives. In this study, 403 patients and their families were examined based on information. In particular, the robot's unique behavior and ease of use have been the most liked by the users [47].
- *Post- Treatment clinical decision process:* It contributes to the physician who has complications after the treatment and whether to continue the treatment.
- *Artificial intelligence-based robotic surgery process:* In our age, some complex hospitals have started to prefer artificial intelligence applications. Physician-assisted artificial intelligence-assisted surgeries are performed anywhere in the world at any time, regardless of place and time. Robots are also used as assistant surgeons in surgery. The Da Vinci Surgical System (The Da Vinci Surgical System) is one of the most commonly used robotic surgery systems [48].
- *Process of interpretation of pathology results:* It is preferred to reduce the presence of very rare cell images, errors caused by staining, and errors caused by wear and tear of the pathologist. Sepsis is a disease with high mortality, and it is a very difficult process to find and detect the relevant pathogen in patients. In an organized study, a classifier model was created with different machine learning methods using a database containing clinical metabolic sepsis patients. Using data from 100 patients in the database, 29 clinical and metabolic feature panels were analyzed. The result reached is the best AUC value (Area Under Cure) of 0.94. According to the results obtained, it was determined that the selected panel could be important biomarkers in distinguishing patients with sepsis [49].
- *Drug treatment and follow-up process:* It is very important for patients to take their drugs in the right cycle, at the right time, and with the right system. Artificial intelligence applications are used in the follow-up of drugs for chronic diseases such as Alzheimer's. By using face recognition technology and artificial intelligence-based systems, the patient's face is recognized, and it is determined whether the drug that the patient wants to take is correct. With the developing technology, it offers new styles for remote monitoring of Parkinson's disease. In a published study, motor nerve behavior was monitored for 6 months by looking at the way and duration of pressing the keys with a developed device. The patient's conditions were classified

with a new deep learning algorithm developed on the result. This study is an example of the use of unattended motor nerve data for drug response and monitoring [50].

- *Drug development process:* It includes valuable, time-consuming, and labor-intensive processes. Support is provided for drug development studies at the molecular level by using artificial intelligence technologies. For example, substances such as many drugs and nutritional supplements can cause oxidative damage to human cell factors. A quantum computer is needed to interpret the results using hydrogen atom transfer to predict the damage that these model materials can cause. A model using machine learning is proposed to assume and predict this effect. Thus, hardware and time costs are significantly optimized for this calculation [51].
- *Diagnosis of diseases:* Information from the Watson Health Platform, the guide, its applications, medical journals and textbooks, and the information in the patient's medical record are taken into account [52]. Moreover, it is possible to detect and mark lesion structures in "Aidoc" imaging results and report them in imaging results in [53]. The "Alive-Cor" deep learning system integrated into the smartwatch is a system that displays rhythm changes based on physical effort and reveals the risk of atrial fibrillation [54]. In addition, the "ResApp Health" application is used to measure various lung conditions such as chronic obstructive pulmonary disease, pneumonia, and chronic asthma [55]. The system uses the phone microphone to predict the breath of the entity. In addition to these applications, Laura, one of the nurse robots, can monitor the hospital's sepsis protocol and early vision through a computer program.
- *Evaluation of patients:* Artificial intelligence-based applications continuously monitor patients' vital signs such as blood pressure, respiratory rate, achromatism, and heart rate monitor. It can cover and send signals in case of emergency [56]. Pre-warning systems based on changes in patient's vital signs in emergency departments and around hospitals such as intensive care units facilitate the recognition of emerging symptoms and the discovery of extremities such as myocardial infarction, arrest, and sepsis, thus increasing the survival rate. Moreover, individualities can be followed in terms of health with applications that are used on mobile devices. Diabetes, eating habits, glucose levels, and effects status of the patients are also followed in the home situation. With these mobile applications, individuals can track themselves in terms of indicators such as step-taking tracking, heart rhythm measurement, and thnumbernt of calories lost per day, and reduce the risk of side effects thanks to early warnings. In the COVID-19 pandemic, artificial intelligence technologies have started to come to the fore more. Artificial intelligence has potential benefits such as early diagnosis, monitoring disease spread, tracking contacts, identifying people at risk, and making projections for the future [57]. In addition, the use of artificial intelligence in determining the virus structure and in drug and vaccine studies can have significant effects on epidemic management. Google published the COVID-19 Community Mobility Report for Turkey on April 5, 2020, which it obtained with a very simple artificial intelligence application [58]. In this report, in line with the epidemic measures, it was determined that mobility at public transport stops decreased by 75% compared to the pre-epidemic period, 60% in parks, 50% in workplaces, and 40% in markets. By developing such a system throughout the country, it will be possible to monitor how much social distance measures are followed during the epidemic period. It is known that systems that monitor the movements, contacts, and disease risks of individuals are used by developing much more detailed artificial intelligence applications during the current COVID-19 epidemic period in China [59]. In the project, individuals were given green, yellow, and red health codes based on big data and mobile internet technologies. While the colors represent their health status, travel history, and whether they have come into contact with people in the epidemic areas, as a

result of the findings, those with red or yellow codes were quarantined for 14 days. Another recently developed application, the COVID-19 Open Research Dataset (CORD-19), contains scientific articles on coronavirus research and is designed to facilitate the development of data mining and information retrieval systems [60]. The application helps scientists to access scientific data quickly. In addition, the World Health Organization has published an information retrieval system developed with artificial intelligence over Whatsapp and Facebook, which enables information about COVID-19 to reach more than 2 billion people [61]. There are studies on various methods based on machine learning for the diagnosis of the virus. Gozes et al. developed an artificial intelligence-based automatic image analysis tool on thorax CT images for the detection and tracking of the virus and reported that the application has a very high success rate [62]. Wang et al. It develops deep learning-based comprehensive tools to determine the respiratory patterns of people through camera images and to help diagnose the disease with the detected patterns [63]. It is also aimed that the developed tools can be used in the detection of COVID-19 on a large scale. Obtaining real-time data is extremely important for artificial intelligence studies and at the same time, it is very difficult to provide this data [64]. Consolidating worldwide patient data and creating accessible databases will make a strong contribution to the current pandemic as well as future outbreaks.

- *Patient home care process:* With the increase in the average life expectancy, the number of people with chronic diseases such as Alzheimer's and Parkinson's is increasing day by day. In addition, the number of older people living alone at home is insignificant. As an example, in 2018, health screenings for 68,400 patients related to the home care process in Finland were carried out in the virtual environment without leaving the house [65].
- *Nursing:* It is very important to collect data, determine appropriate diagnoses, and use technology at all stages of the planning process [66]. The use of robots in nursing was first created with the skeletal systems of laborious processes [67], then robots that connect the patient to a specialist, and assistive robots that carry the necessary equipment for patient care to nurses and store the equipment have been developed [67].
- *Future Trends:* A project named “Human Brain Project” was established in the European Union in 2013, aiming to investigate the differences in the mechanism, structure, and disease of the human brain [68]. The "Starlink Satellite Network" project was initiated by Elon Musk in 2015 to provide fiber-speed internet access, and the "Neuralink Project" became the agenda in 2017, right after. With these two projects, it is planned that the human brain will be subject to subjection and that the human brain will be able to access the internet through software. In addition, in the Neuralink project, it is stated that the neuron conditioning of the mechanism in the human brain can be recorded, and conditions such as "Alzheimer's, Dementia, Parkinson's" can be treated with wireless computer intermediate programs to be placed in the human brain [69].

7. Big Data and Artificial Intelligence Applications

- *Google Deepmind:* The Google Deepmind health project, initiated by Google within the scope of AI research, uses medical records to provide faster and better healthcare. Google Deepmind ensures that the information uploaded to the system is processed within minutes. Although research is currently in its early stages, Google is collaborating with institutions such as Moorfields Hospital and the NHS to develop the system [70].

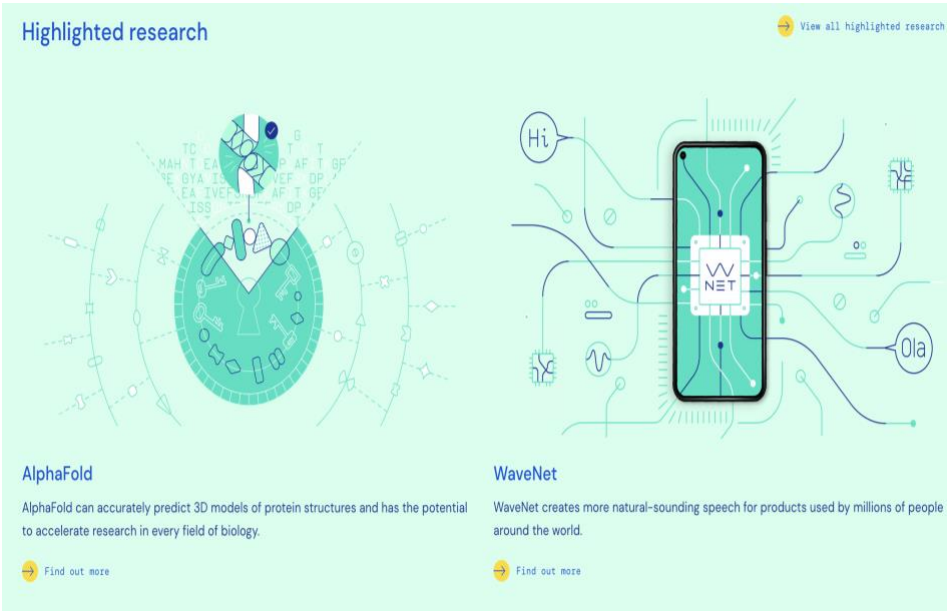

Figure 1. Google Deepmind artificial intelligence page

- *IBM Watsonpaths:* IBM Watson has started an in-house project called WatsonPaths in collaboration with Cleveland Clinic and Lerner Case Western Reserve University School of Medicine. WatsonPaths is designed to help physicians make more informed, more accurate, and faster decisions and to analyze electronic medical records (Electronic Medical Records), based on the Watson AI algorithm; It is a project run by IBM [71].

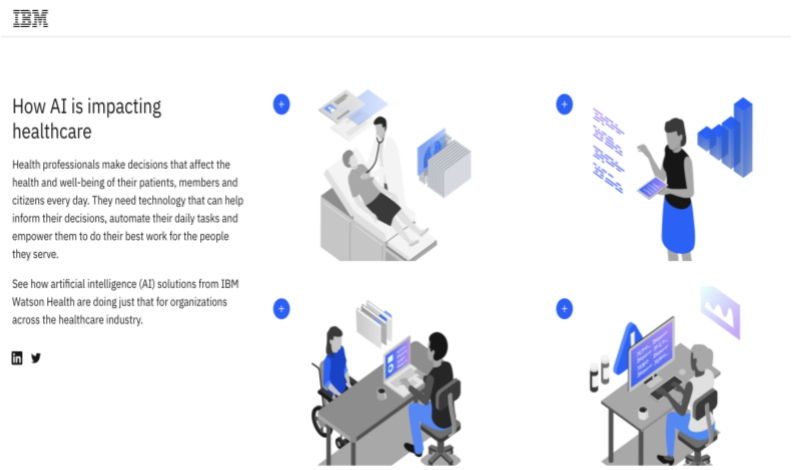

Figure 2. IBM Watsonpaths artificial intelligence page

- *CareSkore:* CareSkore is a Chicago-based platform that provides cloud-based AI solutions for the entire healthcare industry. CareSkore is an artificial intelligence system that basically uses the real-time Zeus algorithm and makes predictions by using the clinical, laboratory, demographic, and behavioral data of the patients as a source. In light of the data it collects, it aims to enable patients to obtain more transparent information about their own health and to increase the service quality of hospitals. In addition, patients can get detailed information about the risks and problems related to AI (artificial intelligence) in their own bodies by registering with this system individually [72].

Figure 3. CareSkore artificial intelligence page

- *Zephyr medicine:* The systems developed by William King Zephyr, who works at Johnson & Johnson, in order to better analyze various data for doctors, which were released to the market in 2011, work on algorithms that will reduce the time required for doctors to choose the right treatment. The project was selected as the first in the field of "Life Sciences" within the scope of "100 Most Inspiring Projects of 2016" by the readers of PharmaVOICE magazine. One of the biggest advantages of this system, which can process a data set very quickly with machine learning algorithms, is that it allows the visualization of big data [73].

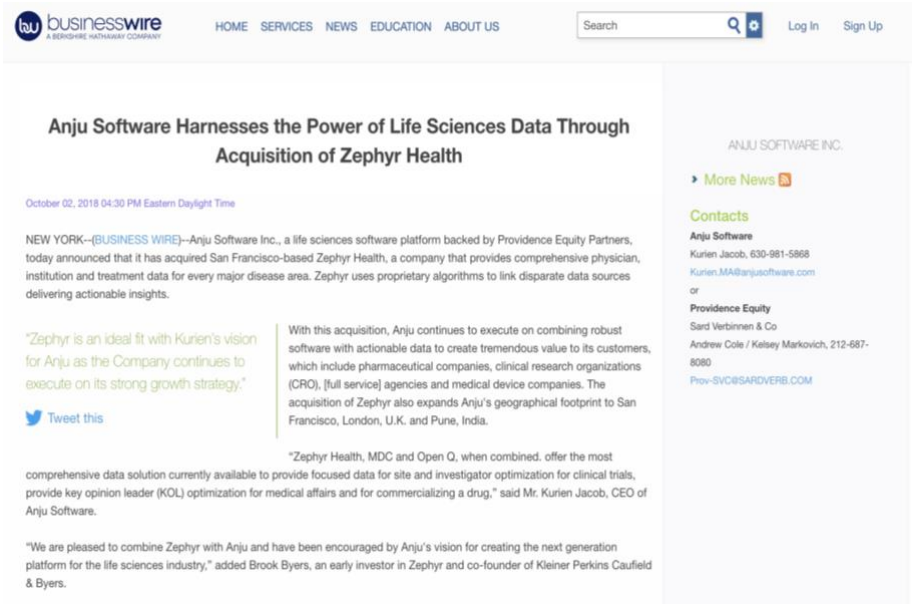

Figure 4. Zephyr Medicine's artificial intelligence page

- *Oncora medicine:* This Philadelphia-based start-up study aims to provide support in cancer research and treatment, especially in the field of radiotherapy. Radiation oncologist David Lindsay, one of the founding partners, created a digital database by organizing the electronic medical records he collected and wanted to design a platform that assists doctors in data analysis and radiotherapy treatment plans. In 2017, three major health centers and their 10,000 patients used the "Radiation Oncology" platform he designed to get help with personalized treatment [74].

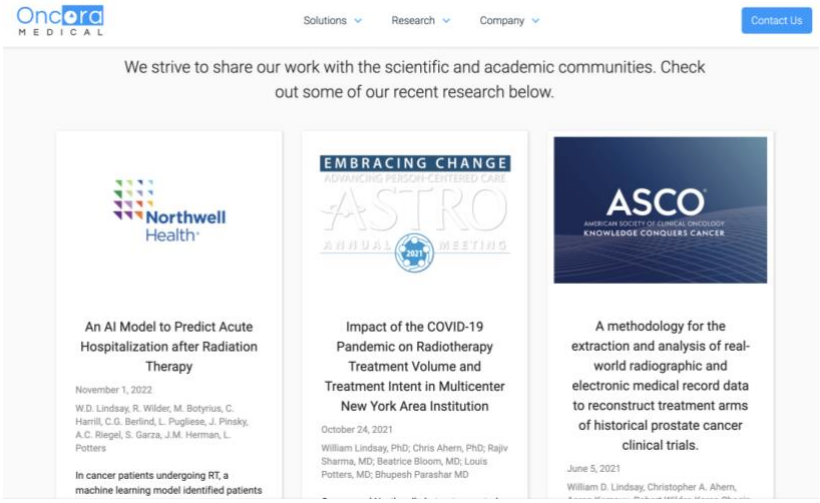

Figure 5. Oncora Medicine artificial intelligence page

8. Artificial Intelligence Applications in Medical Imaging

Medical imaging systems generally include methods for imaging the internal structures of the body. Devices such as X-Ray (X-Ray), MRI, Ultrasonography, and Computed Tomography are just a few of the commonly known ones. What comes to mind first when you think about these imaging techniques? Expensive and complex machines, sometimes even larger than a room. Currently, the biggest reason why these medical imaging technologies cannot become widespread is the expense of the devices and the need for qualified manpower for their use. These problems are exactly what AI start-ups are trying to solve. Although medical imaging systems are widespread in our country, 60% of the world still cannot reach modern medical imaging systems.

- *Enlitic:* It uses the power of image recognition to collect and analyze data, especially in radiographic images, thanks to deep learning technologies. Enlitic's AI interprets medical images in milliseconds, which is roughly 10,000 times faster than the average radiologist's performance in medical image interpretation. In addition, despite the simultaneous reporting of three radiologists in one test, the Enlitic system performed 50% more accurately and faster in classifying malignant tumors [75].

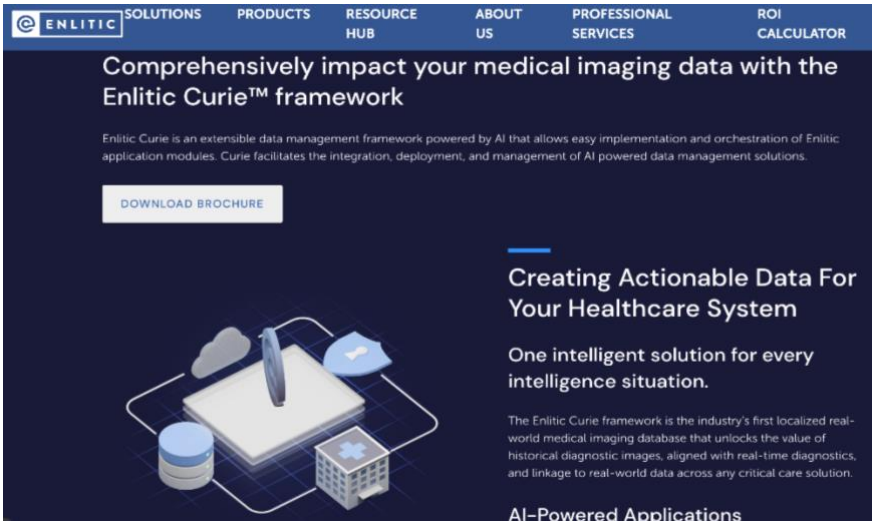

Figure 6. Enlitic artificial intelligence page

- *Butterfly Network:* The start-up, founded by Jonathan Rothberg in 2011, aims with the Butterfly Network to create a new medical imaging device that is significantly inexpensive and efficient from MRI and ultrasound. The ultimate goal of the start-up is to automate the medical imaging process [76].
- *Butterfly Network:* It uses the power of image recognition to collect and analyze data, especially in radiographic images, thanks to deep learning technologies. Enlitic's AI interprets medical images in milliseconds, which is roughly 10,000 times faster than the average radiologist's performance in medical image interpretation. In addition, despite the simultaneous reporting of three radiologists in one test, the Enlitic system performed 50% more accurate and faster in classifying malignant tumors [75].

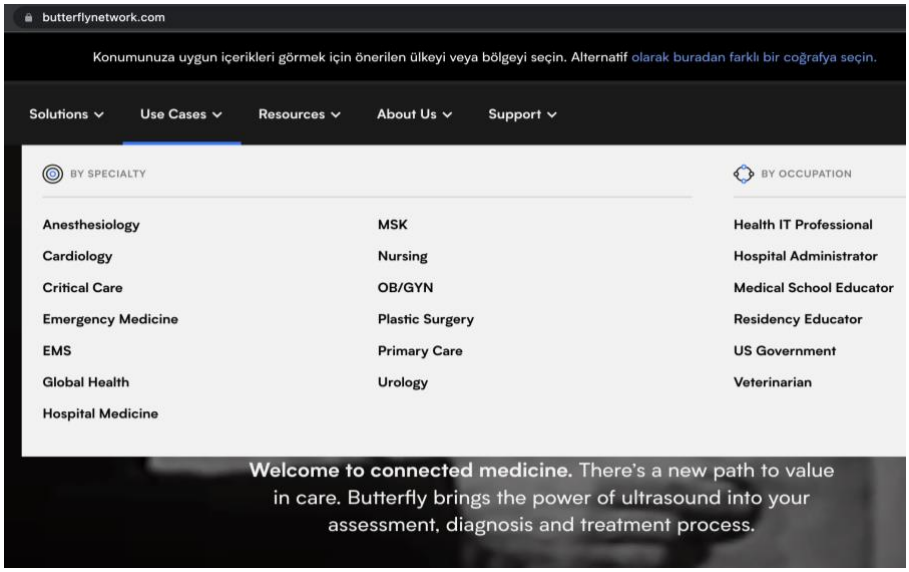

Figure 7. Enlitic artificial intelligence page

- *Lunit:* Founded in 2013, Seoul-based Lunit is the first software company to perform real-time artificial intelligence-based imaging analysis on the Internet. They aim to better model the morphology of lesions, to detect breast cancer early, and to help pathologists or researchers objectively determine the number of lymphocytes infiltrating tumors by examining chest X-ray, mammography, and pathology preparations with their artificial intelligence-based software [77].

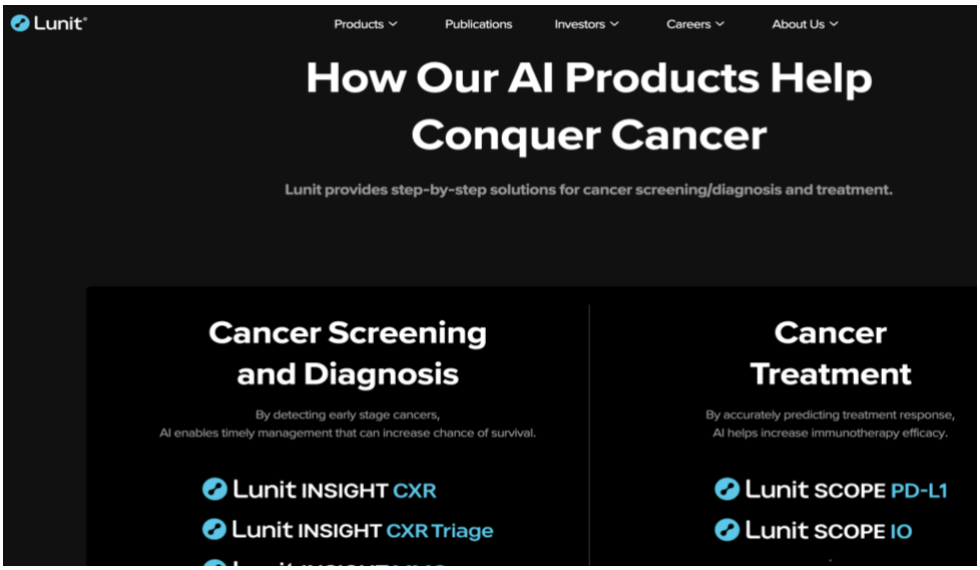

Figure 8. Lunit artificial intelligence page

- *Arterys:* The meeting of cloud, artificial intelligence, and medical imaging. This trio is the focal point of Arterys. The pioneering startup's goal is to "open the cloud power to medical imaging." In this new method developed jointly with GE Healthcare, Cardiac MRI scanning takes 6-10 minutes instead of 1 hour, and the patient does not have to hold their breath during the acquisition. The recordings are designed to be processed on Arterys' platform to obtain many additional data, including 3D heart anatomy, blood flow velocity, and blood flow direction [78].

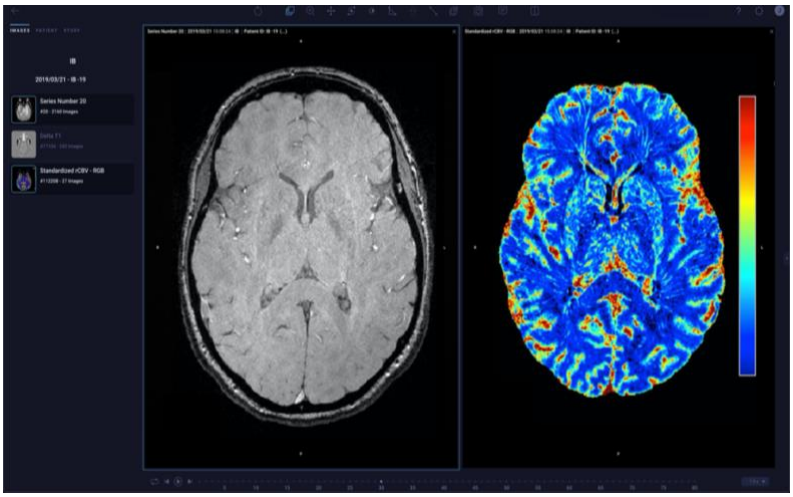

Figure 9. Arterys artificial intelligence page

- *Captain Health:* Bay Labs Inc is designed to assist healthcare professionals in the reporting of ultrasound images during the diagnosis and treatment of heart disease. In 2016, Bay Labs was established to assist in the early diagnosis of Rheumatic heart disease (RHD) in Kenyan school children was established. With this artificial intelligence system, radiologists screened 1200 children in 4 days and managed to diagnose 48 children with RHD and congenital heart disease [79].

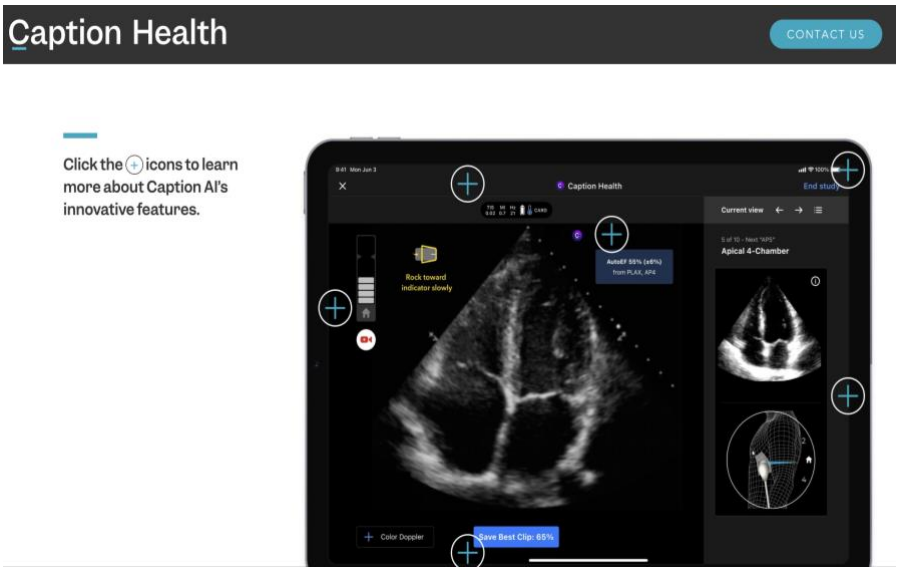

Figure 10. Caption Health artificial intelligence page

Artificial intelligence is widely used in the healthcare field. This technology, which works especially with large data sets, can be used in many areas in the field of health. For example, using artificial intelligence, diseases can be diagnosed, treatment options can be evaluated, and even the effectiveness of drugs can be predicted. Artificial intelligence can also be used in tasks such as data processing and reporting in healthcare systems. Many studies have proven the effectiveness of artificial intelligence in the field of health. For example, in one study, surgical interventions could be made more effective by estimating the size of cancer tumors using artificial intelligence. In another study, it was possible to predict the risk of having a heart attack again in patients who had a heart attack using artificial intelligence.

These examples show that artificial intelligence can be used effectively in the field of health. In the future, the use of this technology in the healthcare field will increase further, and more artificial intelligence applications will be seen in healthcare systems.

9. Benefits and Damages of Al Applications in HealthCare Management

Some of the benefits of artificial intelligence applications can be listed as follows:

1. If the inputs from the physicians are developed in a coordinated manner and the inputs and outputs are explained appropriately, standardization can be determined in the characterization of the disorder, detection, and reporting of the disease, thanks to artificial intelligence.
2. Since there are no continuous studies, it is possible to try to develop solutions to the problems. By combining many algorithms, a better algorithm can be produced (Integration Management) and new solution proposals can be presented.

3. It provides a gain in qualitative and quantitative data groups. For example, interpretation of test results and diagnosis of cancer may be preferred.
4. Different information can be accessed by using data obtained from other examination areas (Radiology, Pathology, Biochemistry, etc.). This information can be used in the diagnosis of different disorders by transforming it into meaningful information by choosing artificial intelligence technologies.
5. Time can be saved.
6. It can make tasks more doable by automating labor-intensive, time-consuming, and costly tasks.
7. Workload can be reduced [80].

When eye field scanning is performed by choosing artificial intelligence technologies, patients who will apply to the physician are pre-filtered. In this way, people who are not sick are prevented from applying to health institutions, while helping those diagnosed with the disease to be directed to the doctor in a faster time. This situation can indirectly play a very important and effective role in both calculating health costs and minimizing costs.

10. Artificial Intelligence Damages In Health Services Management

Some of the harms of artificial intelligence applications can be listed as follows:

1. Problems that may occur due to the fact that the people who shape the algorithm do not have the necessary medical knowledge and equipment, the work schedule of the radiologist is not understood, and the radiologist who will manage the algorithm due to this situation does not have knowledge of the subject, may cause problems due to incorrect use and interpretation. For this reason, multidisciplinary teamwork should be established. In the training process of radiological images, especially the radiologist should follow the images.
2. Accurate and necessary amounts of data sets are needed for image interpretation. It takes a certain amount of time for the data sets to come together, and the processes of checking the authenticity of the data sets are also very laborious.
3. If the data set does not provide enough samples, it may give misleading results.
4. There are no real examples in clinical drug therapy courses
5. It causes a great workload as a large number of images need to be converted to digital images in order to be archived.
6. With the development of technology, more important models based on artificial intelligence should be developed.
7. Necessary measures should be taken for the inadequacy of materials and equipment required for the establishment of the system and financial impossibilities [80].

Necessary measures should be taken for the inadequacy of the materials and equipment required for the establishment of the system and the financial impossibilities.

11. Artificial Intelligence Implementation Process In Turkey

In Turkey, the “National Artificial Intelligence Strategy Preliminary Report” was prepared by “Artificial Intelligence Research Initiative and Door Technology” in 2017 [80]. “Presidential Digital Transformation Office” was opened in 2018 [81]. Artificial intelligence algorithms and clinical decision in Turkey support systems were first able to detect abnormal structures in the brain with an MR imaging device within the scope of the “Turkish Brain Project” in partnership with the digital transformation office and Gazi University, and the reporting process was carried out without the need for a radiologist who performed this process [82]. In 2019, "Turkey Health Data Research and Artificial Intelligence Institute" was established under the Presidency of Turkish Health Institutes. In Turkey, studies on

portable applications have begun to be carried out in order to provide follow-up and operation management in areas such as diabetes, allergy, asthma, and mental health [83]. In addition to these, a program used in the long-term care of chronic diseases and in the follow-up of drugs, diets, and exercises has been created by the Compack company with the "TeleHealth Project". This program can provide follow-up of patients at home after accidents and surgery and support their relatives in the care process [84].

12. Discussion and Conclusion

AI in healthcare is a broad term used to describe machine learning algorithms, software, or artificial intelligence to mimic human cognition in the analysis of complex medical and healthcare data. Recent developments in artificial intelligence are hopeful and exciting in the field of Health as well as in all fields. It is inevitable for the health sector to follow the developments in many sectors in the field of artificial intelligence. However, it should not be expected to progress as fast as in other sectors in a subject such as human health, where it is unacceptable to make mistakes. To get the most out of technology, one must be patient and act cautiously. Developed applications should be evaluated with appropriate scientific studies, and progress should be made in a rational framework based on evidence.

The primary purpose of health-related AI applications is to analyze the relationships between disease prevention or treatment techniques and patient outcomes. Artificial intelligence programs are applied for applications such as diagnosis processes, treatment protocol, and drug development, personalized medicine, patient monitoring, and care. AI algorithms can also be used to analyze large amounts of data through electronic health records for disease prevention and diagnosis. Big technology companies such as IBM and Google have also developed algorithms for healthcare. In addition, hospitals need AI software to reduce costs, increase patient satisfaction, meet staff and workforce needs, and support initiatives. Currently, the United States is investing billions of dollars to advance the development of artificial intelligence in healthcare. Companies are optimizing staffing levels by reducing the number of inpatients and length of stay. In this way, technologies are developed to help health managers improve their work.

As a result, institutions and qualified personnel are needed to evaluate the short and long-term effects of AI. Developers should consider the adoption of appropriate technologies, as well as the assessment and monitoring of security, accountability, and transparency mechanisms. It should be aimed that developing technologies do not increase inequalities in health and that all segments of society can benefit from these services. As with scientific developments, technological developments should also be used to improve health.

Ethical Statement

This paper is exempt from the Institutional Ethics Committee review since it does not involve human subjects.

Acknowledgments

The author did not receive funding from any funding sources in the public, commercial, or not-for-profit sectors and has no sources of support, advice, or competing interests to declare.

Conflicts of Interest

There is no conflict of interest to declare.

Authors Contribution

The article was prepared by one author.

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