Integrating Artificial Intelligence into Telemedicine: Revolutionizing Healthcare Delivery

Authors:

Tahereh Rezaei
Shiraz University of Medical Sciences

Parisa Jafari Khouzani
Isfahan University of Medical Sciences

Soheila Jafari Khouzani
University of New Mexico

Atousa Moghadam Fard
ERIS Research Institute

Sarina Rashidi
Kurdistan University of Medical Sciences

Arezoo Ghazalgoo
Hormozgan University of Medical Sciences

Mehdi Rezaei
Fars-Iranian Heart Association

Masoud Farrokhi
ERIS Research Institute

Amir Moeini
ERIS Research Institute

Laleh Foroutani

Tehran University of Medical Sciences

Shadi Nouri
Arak University of Medical Sciences

Zeynab Moshtaghi
Bushehr University of Medical Sciences

Reza Jahangiri
Tabriz University of Medical Sciences

Tara Mahmoodi
Tehran University of Medical Sciences

Fatemeh Taheri
Islamic Azad University Pharmaceutical Sciences Branch

Ali Jahanshahi
Kerman University of Medical Sciences

Seyed Saeed Mirghazanfari
Guilan University

Benyamin Gheiji
Mashhad University of Medical Sciences

Mahmonir Bayanati
West Tehran Branch, Islamic Azad University

Zeinab Rezaee
Ferdowsi University of Mashhad

Zeynab Abdollahi
Jundishapur University of Medical Sciences

Fatemeh Moeini

Ferdowsi University of Mashhad

Arezou Niknam
University of Tehran

Erfaneh Barar
Shahid Beheshti University of Medical Sciences

Mobina Bagherianlemraski
Mazandaran University of Medical Sciences

Hossein Ghanbari
Iran University of Science and Technology

Zahra Rahimian
Shiraz University of Medical Sciences

Aboulfazl Najafi
ERIS Research Institute

Mohammad-Soroush Khorsand
Azad University Science And Research Branch

Hamidreza Samadpour
Shahid Beheshti University of Medical Sciences

Ali Hashemzadeh
Sri Rajiv Gandhi College Of Dental Science & Hospital

Paniz Sabeghi
Shiraz University of Medical Sciences

Faezeh Jalayer Sarnaghy
Tehran University of Medical Sciences

Amirhossein Mirbolook

Tehran University of Medical Sciences

Rojin Sarallah
Islamic Azad University of Tehran

Mohammad Pirouzan
Alborz University of Medical Sciences

Shirin Varmazyar
Shahroud Azad University of Medical Sciences

Seyed Reza Abdollahi
Ilam University of Medical Sciences

Zahra Pirouzan
Shahid Sadoughi University of Medical Sciences

Nasrin Nouri
Iran University of Medical Sciences

Mikaiel Hajializade
Iran University of Medical Sciences

Shirin Habibi Arvanagh
Iran University of Medical Sciences

Yas Haririan
Shiraz University of Medical Sciences

Javaneh Atighi
Qazvin University of Medical Sciences

Shirin Farsi
Islamic Azad University Science and Research Branch

Azam Darvishi

Queensland University of Technology

Azam Saffar
Tarbiat Modares University

Masoomeh Hajizadeh
Qom Islamic Azad University

Atiyeh Najafighodousi
Amirkabir University of Technology

Zahra Bastami
Zanjan University of Medical Sciences

Hossein Boustani Hezarani
Azerbaijan Medical University

Mohammad Tolouei
Amirkabir University of Technology

Atieh Sadeghniat-Haghighi
Tehran University of Medical Sciences

Azam Abdollahi
Shahid Beheshti University of Medical Sciences

Hana Piroti
Shahid Beheshti University of Medical Sciences

Horrieh Abbasmofrad
Rahman Institute of Higher Education

Amirali Momayezi
Iran University of Science and Technology

Maede Hosseinnia
Isfahan University of Medical Sciences

Arman Salehi
Rafsanjan University of Medical Sciences

Fatemeh Farrokh

Shahid Beheshti University of Medical Sciences

Babak Goodarzi
Iran University of Medical Sciences

Book Details:

Publisher: Kindle

Publication Date: October 2023

Language: English

Dimensions: 5 x 0.39 x 8 inches

Contents

Chapters

1- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF RENAL DISEASES

Introduction

Renal diseases, encompassing conditions such as chronic kidney disease (CKD) and end-stage renal disease (ESRD), present a significant healthcare challenge worldwide. Effective management of renal diseases requires accurate diagnosis, monitoring of disease progression, and personalized treatment plans. The integration of Artificial Intelligence (AI) into telemedicine holds immense potential to transform the way renal diseases are managed. This article explores the applications of AI in telemedicine specifically for the management of renal diseases, highlighting its benefits, challenges, and future prospects.

Enhanced Diagnosis and Decision Support

AI can significantly improve the accuracy and efficiency of diagnosing renal diseases. Machine learning algorithms can analyze large datasets of patient information, including medical records, laboratory results, and imaging studies, to identify patterns and indicators of renal diseases.

This enables healthcare providers to make more informed decisions regarding diagnosis and treatment. AI-powered decision support systems can assist clinicians by providing real-time recommendations based on evidence-based guidelines and expert knowledge.

Remote Monitoring and Early Detection

Telemedicine, combined with AI, enables remote monitoring of patients with renal diseases. Wearable devices and sensors can continuously collect data on vital signs, fluid balance, and biochemical markers, which are then transmitted to healthcare providers for analysis. AI algorithms can analyze this data to detect subtle changes and identify early signs of complications or disease progression. Timely intervention based on these insights can prevent adverse outcomes and reduce the need for hospitalizations.

Personalized Treatment Plans

AI algorithms can assist in developing personalized treatment plans for patients with renal diseases. By considering individual patient characteristics, such as age, comorbidities, and genetic factors, AI can help determine optimal medication dosages, lifestyle modifications, and dietary recommendations. This personalized approach improves treatment efficacy and patient

adherence, leading to better outcomes.

Predictive Analytics and Risk Stratification

AI techniques, such as predictive analytics, can aid in risk stratification for patients with renal diseases. By analyzing historical data and patient profiles, AI algorithms can predict the likelihood of disease progression, identify high-risk individuals, and prioritize interventions. This enables healthcare providers to allocate resources effectively and provide targeted interventions to those who need them the most.

Teleconsultation and Virtual Collaborations

AI-powered teleconsultation platforms facilitate remote communication and collaboration between healthcare providers, including nephrologists, primary care physicians, and specialists. Through secure video conferencing and data sharing, experts can review patient cases, provide consultations, and offer guidance in real-time. This enhances access to specialized care, particularly for patients in underserved areas, and promotes interdisciplinary collaboration.

Challenges and Considerations

While the integration of AI into telemedicine for renal disease management holds tremendous

potential, several challenges must be addressed. Data privacy and security concerns, along with regulatory compliance, must be carefully managed to protect patient information. The ethical implications of AI, including transparency and accountability, should also be considered. Additionally, the implementation of AI systems requires robust validation, rigorous testing, and ongoing monitoring to ensure accuracy, reliability, and safety.

Future Prospects

The future of integrating AI into telemedicine for renal disease management looks promising. Advancements in AI technologies, such as deep learning and natural language processing, will further enhance the capabilities of AI algorithms. Integration with emerging technologies, such as Internet of Things (IoT) devices and blockchain, can improve data interoperability and enhance the security of patient information. Collaborative efforts between researchers, healthcare providers, and technology developers are essential to drive innovation and realize the full potential of AI in telemedicine for renal diseases.

Improving Medication Management

AI technology can play a crucial role in enhancing medication management for patients with renal

diseases. AI algorithms can analyze patient data, including medication history, laboratory results, and comorbidities, to identify potential drug interactions, optimize medication regimens, and prevent adverse drug events. AI-powered systems can provide medication reminders and alerts to patients, ensuring adherence to prescribed medications and reducing the risk of medication-related complications. Moreover, AI can assist healthcare providers in monitoring medication efficacy and adjusting dosages based on real-time patient data, leading to improved treatment outcomes.

Tele-rehabilitation and Remote Support

Rehabilitation is an essential aspect of renal disease management, particularly for patients undergoing dialysis or recovering from kidney transplant surgery. AI-powered tele-rehabilitation platforms can provide remote support and guidance to patients, enabling them to perform prescribed exercises and monitor their progress. Virtual rehabilitation sessions, combined with wearable devices and motion-tracking technology, can facilitate real-time feedback and ensure proper technique and adherence to rehabilitation protocols. This remote approach to rehabilitation not only improves patient convenience but also enhances engagement and promotes better

functional outcomes.

AI-enabled Decision-making in Renal Transplantation

Renal transplantation is a complex procedure that requires careful evaluation of both donors and recipients. AI can assist transplant teams in streamlining the decision-making process by analyzing various factors, such as donor-recipient compatibility, immunological profiles, and long-term graft survival predictions. By leveraging machine learning algorithms, AI can provide insights into the likelihood of transplant success and guide clinicians in selecting suitable candidates for transplantation. This AI-enabled decision support can optimize organ allocation and improve transplant outcomes, ultimately saving more lives.

Overcoming Barriers to Adoption

While the potential benefits of integrating AI into telemedicine for renal disease management are evident, there are still barriers to widespread adoption. One significant challenge is the integration of AI systems into existing healthcare infrastructures and electronic health record (EHR) systems. Interoperability issues, data standardization, and compatibility with different telemedicine platforms need to be addressed to ensure seamless integration and data exchange.

Additionally, healthcare provider training and education on AI technologies are crucial to promote acceptance and effective utilization of AI tools in clinical practice.

Ethical Considerations and Patient Trust

As AI becomes more prevalent in healthcare, ethical considerations surrounding privacy, transparency, and patient autonomy must be carefully addressed. Patients need to have confidence in the security and confidentiality of their medical data when using AI-powered telemedicine platforms. Transparent algorithms and clear explanations of AI recommendations are essential to foster trust between patients and healthcare providers. Moreover, ensuring equitable access to AI-driven telemedicine services is crucial to prevent exacerbating existing healthcare disparities.

Collaboration and Future Directions

The successful integration of AI into telemedicine for renal disease management requires collaboration among various stakeholders. Healthcare providers, researchers, technology developers, and regulatory bodies should work together to establish guidelines, standards, and best practices for AI implementation.

Collaborative research efforts can further enhance the capabilities of AI algorithms, refine predictive models, and improve the accuracy of diagnostic tools. Additionally, continuous monitoring, evaluation, and feedback loops are essential to drive iterative improvements and refine AI systems over time.

Conclusion

Integrating Artificial Intelligence into telemedicine presents a transformative approach to the management of renal diseases. AI-powered diagnostic support, remote monitoring, personalized treatment plans, and predictive analytics offer immense benefits to patients and healthcare providers. While challenges exist, addressing issues related to data privacy, ethical considerations, and regulatory compliance can pave the way for widespread adoption of AI-driven telemedicine solutions. With continued advancements and collaborative efforts, AI has the potential to revolutionize renal disease management, improving patient outcomes, and reducing healthcare burdens globally.

2- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF NEUROLOGICAL DISEASES

Integrating artificial intelligence (AI) into telemedicine for the treatment of neurological conditions presents both promising possibilities and obstacles. Telemedicine, as a developing approach, has the potential to enhance healthcare accessibility, facilitate specialized consultations, offer diagnostic assessments, provide rehabilitation, and enable remote monitoring for neurological disorders. On the other hand, AI has demonstrated its effectiveness in analyzing complex medical data and identifying significant connections, making it a valuable asset in managing neurological diseases.

The following provides an overview of the utilization of AI and telemedicine in the management of some neurological disorders:

Stroke: AI models utilizing machine learning algorithms have the capability to forecast the likelihood of a subsequent stroke occurring within a year following a transient ischemic attack (TIA) or a minor stroke. Furthermore, the utilization of AI in telestroke applications has witnessed a notable rise, primarily aimed

at facilitating prompt stroke diagnosis and decision-making. Notably, AI algorithms have been devised to effectively detect ischemic stroke in computed tomography (CT) and electroencephalography (EEG) images, thereby expediting the diagnostic process and enhancing its accuracy. Furthermore, AI-powered devices are being employed to monitor heart rate and heart rate variability, as well as to screen for asymptomatic atrial fibrillation, using advanced techniques such as photoplethysmography and handheld electrocardiograph recorders. These devices offer enhanced accuracy in detecting potential irregularities in heart function, thereby aiding in the prevention of embolic stroke.

Epilepsy: AI algorithms have the potential to aid in the acquisition, organization, and categorization of patients' clinical data, specifically EEG signals, with the aim of substantially decreasing the duration required for epilepsy diagnosis. In addition, wearable devices utilizing AI have the capability to identify seizures and notify caregivers, as well as mobile applications available that enable patients to monitor their symptoms and medication.

Parkinson's Disease: Smartphone-based questionnaires can obtain patient data such as demographics and medication usage, and some wearable devices analyze body tremors. Finally, all this captured data is fed into a deep learning model

to diagnose Parkinson's disease. Furthermore, AI-powered mobile applications have the capability to gather and analyze patient data, monitor and manage motor symptoms from a remote location, and assess the effectiveness of treatment responses.

Multiple Sclerosis (MS): AI has the potential to remotely evaluate the disability level of individuals with MS. An instance of this is the utilization of AI to score the Expanded Disability Status Scale (EDSS) through telephone assessments. Furthermore, applications utilizing AI have the potential to empower patients and improve their adherence to therapeutic and management protocols for their medical conditions. Additionally, these apps can be employed to gather personalized data on the progression patterns of MS for individual patients. This data can then be utilized by healthcare professionals to provide evidence-based guidance and support for patients in enhancing their self-management of the disease.

Alzheimer's Disease: An AI-based EEG brain scanning technique has demonstrated the ability to effectively categorize the presence of beta-amyloid buildup in the brain, a defining characteristic of Alzheimer's disease. This innovative approach holds promise for the early detection and ongoing monitoring of Alzheimer's disease, potentially enabling timely diagnosis and

assessment of disease advancement. Moreover, AI-powered wearable devices have the potential to offer immediate notifications to individuals with Alzheimer's disease, thereby enhancing the quality of patient care, tailoring individualized treatment plans, and ultimately leading to better health outcomes.

Integrating AI into telemedicine for the management of neurological diseases has demonstrated encouraging outcomes; however, there are several obstacles that need to be addressed. These challenges encompass safeguarding the privacy and security of patient information, mitigating potential biases in AI algorithms, and validating AI-driven systems across various clinical contexts. Furthermore, it is imperative to establish regulatory frameworks and guidelines to govern the utilization of AI in telemedicine, thereby ensuring patient safety and promoting evidence-based practice.

As AI technology advances, the potential applications of AI in telemedicine for neurological disease management are vast. Future research should focus on developing more sophisticated AI algorithms for disease diagnosis and monitoring, as well as exploring the potential of AI-assisted telerehabilitation and personalized treatment planning.

Artificial intelligence (AI) and its branches, Machine Learning (ML) and Deep Learning, have

promoted the development of today's technology, which is increasingly applied in medicine, especially in neurology. AI, in particular, is not a replacement for neurologists but a valuable tool that may provide new insights into clinical management and therapeutic interventions in neurology. Artificial intelligence algorithms using Deep Learning (DL) and Machine Learning (ML), implemented in telemedicine, can also facilitate the accuracy of prediction, diagnosis, and treatment of neurological diseases for patients who are located at a distance in rural areas. With a shortage of specialized clinicians and limitations in diagnosis and therapeutic windows, there is a need for innovative ideas in stroke management to improve patient outcomes. Teleneurology is one example of this innovation, which is a branch of telemedicine that has helped improve stroke outcomes over the last two decades.

AI has become integrated into the field of vascular neurology, with a focus on integrating it into telestroke, which provides neurocritical care in acute stroke, to make diagnostic decisions for determining IV alteplase candidacy and provide guidance to triage patients who might be eligible for a mechanical thrombectomy. AI, by using Intelligent electronic medical records (EMR), which is one of the newest innovations in keeping medical records, can predict the prognosis and 3-month treatment outcomes in the first 48 hours

after a stroke based on the stroke scale score. Neurodegenerative diseases such as Alzheimer's disease (AD) and Parkinson's disease (PD) cause the progressive death of central nervous system neurons, leading to brain dysfunction.

Neuroimaging findings in the case of neurodegenerative diseases can help identify focal atrophy patterns. Deep neural networks (DNNs) are highly proficient in predicting diagnoses based on neuroimaging findings. Through machine learning techniques and data modalities, such as movement data (such as handwriting patterns, gait features, and voice signals for speech problems) alongside neuroimaging findings, we are able to have a precise diagnosis of PD in early stages and make better treatment recommendations. Speech and voice difficulties in PD include hypophonia (vocal musculature disharmony) and dysphonia (weak vocal fluency), dysarthria, and language disorders. Gait difficulties include general slowness of movement (hypokinesia), small, shuffling steps, and in severe cases, complete immobility (akinesia).

Machine learning algorithms have the potential to predict the progression of dementia in 2 years. Alzheimer's disease is the most common type of dementia, and although the causal mechanism of AD remains unclear, Aβ and tau proteinopathies are unique defining features of AD, with the deposition of these proteins beginning almost

10-20 years before the initiation of Alzheimer's symptoms. "The World Health Organization predicts that by 2050, the number of individuals affected by Alzheimer's disease (AD) will be three times higher than the current figure, emphasizing the need for advancements in early diagnosis" for the well-being of individuals and society. AI prescreening algorithms would be employed to categorize individuals by utilizing predicted protein (Aβ and tau) biomarkers and/or MRI biomarkers and PET brain images.

Efforts are being made to utilize neuroimaging methods like functional magnetic resonance imaging (fMRI), positron emission tomography (PET), and single photon emission computed tomography (SPECT) to identify distinctive indicators of early Alzheimer's disease (AD) for therapeutic interventions that can delay the progression of the disease. Artificial neural networks (ANN) and SPECT cerebral blood flow testing can be useful tools for discriminating AD patients from healthy patients. Additionally, AI has the potential to assist in the identification and monitoring of functional abilities in individuals experiencing normal aging and mild cognitive impairment. It has been suggested that unobtrusive sensors could be utilized to passively assess routine driving, offering valuable insights into any decline in functionality. By analyzing the data collected from these sensors, AI algorithms

can detect alterations in driving behavior that may serve as indicators of cognitive impairment.

Moreover, AI can improve the level of engagement and emotional response among elderly individuals suffering from dementia. In a pilot study, researchers utilized a robotic animal named CuDDler and observed its positive impact on engagement and emotional response. By employing AI algorithms, robots can adjust their behavior according to individual preferences and requirements, resulting in a more customized and interactive experience for those with dementia.

However, it is important to note that integrating AI into telemedicine for the management of neurological diseases also comes with challenges. Privacy and security concerns must be addressed to ensure the protection of patient data. Additionally, there may be a learning curve for healthcare providers in adopting and effectively utilizing AI-powered telemedicine platforms. Collaboration between healthcare professionals, AI developers, and regulatory bodies is crucial to address these challenges and ensure the safe and effective integration of AI into telemedicine.

The User Experience of Integrating AI in Teleneurology

The term "user experience," coined by Don Norman in 1993, is concerned with the creation of interactive products and services for

people. The entire human-device interaction and human-human context need to be considered. Principles and practices of design from various technologies, psychology, and cognitive science are used in user experience, encompassing usefulness, functionality, usability, impact, and visual design. The usability of these products and services is uniquely important as a combination of ergonomics, human-device interaction, and emotional design. It is about considering the effectiveness, efficiency, engagement, error tolerance, and ease of learning of interactions between humans and everyday communication and computing devices embedded in medical devices.

According to the literature, many industries utilize Artificial Intelligence (AI) technology to enhance the experiences of patients with teleneurology devices, services, and systems. AI has been used to analyze data from a patient's medical history, diagnostic tests, and physical exams to assist in making accurate diagnoses. AI algorithms can automate image classification and prediction, including stroke detection, to improve the quality of care through the rapid interpretation of clinical data. One of the most significant advancements in AI for robotic teleneurology is the development of AI-powered robots equipped with cameras and sensors that can be remotely controlled by a neurologist to

perform neurological examinations. This saves time and resources, reduces error rates, and makes neurological care accessible to patients in remote areas. Overall, studies have shown that the use of AI and Machine Learning (ML) can revolutionize the accuracy and efficiency of teleneurology diagnosis, facilitate advancements in monitoring and prediction, improve communication between healthcare providers and patients, and increase access to specialist care. Ultimately, these benefits lead to effective and efficient patient-centered care. One technological advancement in healthcare for neuromuscular disorders involves the use of surface and wireless electromyographic sensors to perform dynamic and static posturography in assessing balance problems. These devices allow physicians to evaluate balance problems both in the lab and at home.

Despite these developments, there are still questions that need to be answered regarding how AI might be used in teleneurology. For example, one of the emerging challenges in integrating virtual care within neurology is creating a friendly, intuitive, and delightful user experience. The system will be frequently used by groups of patients with certain disabilities, including the elderly, and special inclusive visual signifiers, such as large icons and font sizes, should be a design priority. Similarly, software user experience and user interface design are increasingly important

for neurologists and neurosurgeons to adjust their workflow, establish a meaningful rapport, reduce care latency, and enhance documentation times. The four key principles of patient-centered teleneurology are enhancing patient experiences, reducing costs, improving communication in health, and improving the work-life balance of clinicians.

Integrating Artificial Intelligence into Telemedicine for the Management of Stroke

Introduction

In recent years, the utilization of AI and machine learning in the prevention, diagnosis, risk stratification, patient monitoring, and therapeutic decision-making of various disorders has become widespread. The prevalence of chronic neurological disorders has significantly increased as the population has grown and aged, despite a decrease in mortality rates associated with stroke and other communicable neurological diseases. Stroke ranks as the primary cause of disability and the fifth leading cause of mortality in the United States. Annually, approximately 795,000 individuals in the country experience new or recurrent strokes. Direct medical expenditures associated with stroke are approximately 24 billion dollars, but only a small percentage of eligible patients receive a crucial treatment called

intravenous thrombolytic therapy. This is due to reasons such as the risk of hemorrhage, limited physician experience, geographic challenges faced by patients in rural areas, and occurrences of wake-up strokes or unwitnessed strokes. Early detection, rapid intervention, and comprehensive rehabilitation are essential for effective stroke management. Hence, the integration of AI technology and telemedicine in stroke assessment can provide beneficial outcomes.

Telemonitoring and Remote Rehabilitation Using AI

Telemedicine, including teleneurology, has enabled healthcare professionals to provide care to patients who may lack access or face scheduling challenges for in-person appointments. Teleneurology has shown promising results in acute stroke and neurocritical care settings, leading to high levels of patient satisfaction and potential cost savings. By enhancing the accessibility of neurological care, teleneurology addresses physician shortages, reduces delayed diagnoses and treatments, minimizes unnecessary patient transfers, and improves care continuity. Additionally, telestroke has been proven to be as accurate as bedside evaluations in diagnosing acute stroke and aids in efficient diagnostic decision-making, determination of IV alteplase eligibility, and guidance for thrombolysis

administration. It also helps triage patients for mechanical thrombectomy.

Imaging and AI

Imaging plays a central role in the assessment and treatment of stroke patients. However, concerns have been raised regarding the time delays associated with certain advanced imaging techniques, such as CT perfusion or MRI. These techniques often require longer acquisition and processing times compared to non-contrast CT and CT angiography. While most MRI stroke protocols require less than 10 minutes of scan time, MRI generally involves more comprehensive screening and patient transfer time than CT. Therefore, reducing MRI scan time is crucial, considering the superior tissue contrast of Diffusion-Weighted Imaging (DWI) in identifying irreversibly damaged tissue. AI-driven approaches, particularly deep convolutional neural networks (CNNs), have the potential to enhance the quality of medical images, enabling faster acquisition and reduced radiation dosage. For example, CNNs can denoise MR brain perfusion images obtained through arterial spin labeling, creating diagnostic images with shorter scanning durations. AI can also be employed in other MR sequences, such as quantitative susceptibility mapping, to detect brain hemorrhage and calcification. Additionally, AI-based approaches can potentially decrease the

amount of gadolinium required for diagnostic imaging, addressing concerns related to gadolinium deposition. In CT perfusion imaging, CNNs can help minimize radiation dosage, mitigating radiation-related concerns.

AI-Assisted Decision-Making in Acute Stroke Treatment

Decision-making in acute stroke treatment is complex and time-pressured. Developing predictive models based on individual pathophysiology is critical for guiding clinical practice. Automating certain aspects of these models, such as calculating volumes of the ischemic core or penumbra from CT perfusion images, can provide decision support. However, it is important to note that automated processes should not replace individual patient management decisions. Decision support systems should align with the decision-making process faced by stroke clinicians, considering patient-specific factors and care system constraints. Two types of decision support models are suitable: decision automation and routine decision support models. Decision automation automates frequent and routine processes, while routine decision support models assist clinicians in making repeated routine decisions but do not replace them.

Automated ASPECTS Scoring

Alberta Stroke Program Early CT Score (ASPECTS) is a standardized scoring system used to evaluate early ischemic changes in CT scans. The ASPECTS score ranges from 0 to 10, with lower scores indicating a greater extent of ischemia and poorer outcomes. ASPECTS scoring is critical for determining eligibility for thrombolysis and endovascular thrombectomy. However, manual ASPECTS scoring is time-consuming and can lead to inter-observer variability. AI-based approaches can automate ASPECTS scoring, providing accurate and efficient assessments of early ischemic changes. For example, deep learning techniques such as CNNs can be trained to identify ischemic changes in CT images and provide automated ASPECTS scoring. These models can reduce inter-observer variability and increase accuracy, thereby improving patient outcomes.

Challenges and Limitations

Despite the numerous benefits offered by telestroke, there remain several challenges and limitations that must be addressed. One significant challenge is interoperability, which hinders the seamless integration of telestroke services. It is crucial to overcome data silos and establish a universal and secure information-exchange system. This will enable the provision of cost-effective and efficient care to patients

while also preserving the clinician experience and avoiding moral injury. Another limitation for effective AI integration in telestroke programs is the requirement for broadband access and connectivity to fast, reliable internet. AI systems must be capable of operating at the edge, rather than relying solely on cloud computing. Additionally, there is a need to optimize wireless internet infrastructure, both indoors with Wi-Fi and on mobile platforms with 5G technology.

3- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF GASTROINTESTINAL DISEASES

Integrating Artificial Intelligence (AI) into telemedicine can revolutionize how we diagnose, treat, and monitor gastrointestinal (GI) diseases. Recent studies show AI usage in gastroenterology and endoscopy practices, with promising results. AI has been used for the definition of mucosal healing, prediction of the disease, symptom severity in the future, and the treatment of inflammatory bowel disorder (IBD). Machine learning and AI are important for diagnosing functional GI disorders and aiding healthcare professionals.

AI and all the related technologies could address the challenges associated with longitudinal care and health disparities. AI-assisted endoscopy is based on deep learning algorithms that can identify and classify lesions in real-time, improving diagnostic accuracy and reducing the need for biopsies. AI can also be used to analyze and interpret medical images, such as positron emission tomography (PET) scans, computed tomography (CT) scans, sonography, magnetic resonance imaging (MRI), colonoscopy, and endoscopic images, to aid in the diagnosis and

management of GI diseases.

Additionally, AI technology in telemedicine personalizes care and treatment according to each patient's plans. AI algorithms can analyze electronic health records (EHRs) of patients to recognize patterns and predict outcomes, customizing treatment plans for individual patients. AI can also be used to remotely monitor patients, allowing for early detection of complications and timely intervention.

Despite the benefits of AI in telemedicine, there are also challenges that should be noticed. These include the need for data privacy and security, the risk of bias in AI algorithms, and the need for regulatory oversight. Additionally, training healthcare providers in the use of AI and understanding its limitations and potential pitfalls is important.

Telemedicine can improve access to healthcare, modify healthcare costs, and increase the quality of care. While there are challenges that need to be addressed, the potential benefits of telemedicine are significant and warrant further exploration and development. The use of telemedicine can also help address health disparities, particularly in rural areas where access to healthcare is limited. Telemedicine can provide access to specialists and healthcare services that may not be available locally, improving patient outcomes and reducing healthcare costs. In addition to improving access

to healthcare, telemedicine can also improve the quality of care provided. Telemedicine provides caregivers with access to patient data and medical records, allowing for more informed decision-making and better coordination of care.

However, there are also challenges associated with the use of telemedicine. These include the need for reliable and secure internet connectivity, the potential for technical difficulties, and the need to train caregivers in the use of the technology. Despite these challenges, the use of telemedicine is expected to continue growing in the future. The COVID-19 pandemic facilitated the adoption of telemedicine, with many healthcare providers and patients turning to telemedicine as a way to safely provide and receive healthcare services.

In conclusion, the integration of AI into telemedicine for the management of GI diseases can improve patient outcomes and revolutionize the way we diagnose, treat, and monitor these conditions. Although there are challenges that should be considered, the potential benefits of AI in telemedicine are significant and warrant further exploration and development. The use of telemedicine can also help address health disparities, facilitate access to healthcare, modify healthcare costs, and improve the quality of care provided.

Telemedicine provides a communication platform between patients and physicians via electronic

devices. Its role in the management of chronic diseases, including gastrointestinal (GI) disorders, is growing. Since the COVID-19 pandemic, the implementation of telemedicine in various disorders has increased. A study by Serper et al. showed that telemedicine covered 94% of gastrointestinal/hepatology visits during the pandemic.

Hepatic Diseases

For hepatic diseases, Cross RK et al. revealed that telemedicine could efficiently achieve resolution consultations without the need for face-to-face consultations, especially in younger patients without a history of alcohol abuse, chronic liver disease, and diabetes mellitus. Such conclusive telemedicine consultations are mainly obtained in benign hepatic processes such as viral hepatitis, non-alcoholic fatty liver disease (NAFLD), and benign hepatic nodules. In 2003, a telemedicine model called "Extension for Community Healthcare Outcomes (ECHO)" was utilized in resource-limited regions of New Mexico. This approach provided better management of chronic diseases such as HCV with the help of specialists.

IBD (Inflammatory Bowel Disease)

Inflammatory bowel disease (IBD) is a chronic GI disorder characterized by diarrhea,

abdominal pain, and weight loss, requiring lifelong treatment. Telemedicine programs such as Constant-care and myIBDcoach have demonstrated good performance in patient satisfaction and treatment adherence. The home telemanagement system (HAT) is another telemedicine approach that has shown incremental effects on the quality of life of patients with IBD, in addition to the reduction in disease activity assessed both clinically and paraclinically. IBD Monitoring Index for Mobile Health and IBD disk have also been introduced for the management and monitoring of disabilities related to IBD [20-27]. A systematic review of the role of telemedicine in IBD management showed no significant difference in patient satisfaction or disease activity between people who received telemedicine care and patients who obtained face-to-face visits.

IBS (Irritable Bowel Disease)

In irritable bowel syndrome (IBS), a telemedicine program called Constant-Care was used to assess the severity score of IBS patients, showing an outstanding decrease. Telemedicine-based cognitive behavioral therapy has also been successful in reducing GI symptoms in IBS patients. Another IBS self-management program (Regul8) showed promising results in disease relief. In a systematic review of 20 articles, Helsel BC et al. concluded a good rate of patient

compliance in IBS.

Colorectal Cancer

Telemedicine has shown good performance in the screening and surveillance of colorectal cancer. In a study by Kearney N, a smartphone application called the advanced symptom management system (ASyMS) has been helpful for managing post-chemotherapy symptoms, including GI discomforts, in patients with colorectal cancer.

Outpatient Gastroenterology Visits

Telemedicine has also been successful in addressing the management of mild GI discomforts such as heartburn and abdominal pain, as well as screening and surveillance of colorectal cancer in outpatient gastroenterology visits.

Limitations

However, telemedicine has some drawbacks, despite its advantages, which are not specific to GI disorders. Older patients may have more problems with the usage of electronic devices or applications, and they may more frequently suffer from hearing problems that interfere with optimal use. Additionally, educational training courses for gastroenterologists are not available worldwide. Furthermore, the physical examination, which is

an essential part of each visit, is limited in telemedicine settings.

4- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF CARDIAC DISEASES

Introduction

Cardiac diseases, including conditions such as coronary artery disease, heart failure, and arrhythmias, are a leading cause of morbidity and mortality worldwide. Timely and accurate management of cardiac diseases is crucial for improving patient outcomes. The integration of Artificial Intelligence (AI) into telemedicine offers a promising approach to enhance cardiac disease management by enabling remote monitoring, improving diagnostic accuracy, and facilitating personalized treatment plans. This article explores the applications of AI in telemedicine specifically for the management of cardiac diseases, highlighting its benefits, challenges, and future prospects.

Remote Monitoring and Early Detection

Telemedicine, coupled with AI, enables remote monitoring of cardiac patients, allowing for continuous assessment of vital signs, cardiac rhythms, and other physiological parameters.

Wearable devices equipped with sensors and AI algorithms can analyze real-time data, detecting abnormalities or changes that may indicate a deterioration in cardiac health. By providing early detection and timely intervention, remote monitoring can prevent adverse events, reduce hospitalizations, and improve patient outcomes.

ECG Analysis and Diagnosis

AI algorithms can analyze electrocardiogram (ECG) data with high precision and speed, aiding in the diagnosis of cardiac diseases. Machine learning techniques can detect subtle ECG patterns associated with specific conditions, such as myocardial infarction or arrhythmias, and provide automated interpretations. This assists healthcare providers in making accurate diagnoses, especially in cases where access to specialized cardiologists is limited. AI-powered ECG analysis can expedite the diagnostic process and facilitate prompt treatment decisions.

Predictive Analytics and Risk Stratification

AI techniques, such as predictive analytics, can assist in risk stratification for cardiac patients. By analyzing patient data, including medical history, laboratory results, imaging studies, and genetic information, AI algorithms can identify individuals at high risk for adverse cardiac

events. This risk stratification enables healthcare providers to prioritize interventions and allocate resources effectively. Furthermore, AI algorithms can predict the probability of future cardiac events, facilitating personalized preventive strategies and improving patient outcomes.

Personalized Treatment Plans

AI can assist in developing personalized treatment plans for cardiac patients, considering individual characteristics, such as age, comorbidities, and genetic factors. AI algorithms can analyze large datasets to identify optimal medication regimens, dosage adjustments, and lifestyle modifications tailored to each patient's specific needs. This personalized approach improves treatment efficacy, enhances patient adherence, and reduces the risk of adverse drug reactions.

Teleconsultation and Virtual Cardiology Services

AI-powered teleconsultation platforms enable remote communication and collaboration between healthcare providers and patients. Cardiologists can review patient data, including medical history, diagnostic test results, and imaging studies, through secure video conferencing. AI algorithms can assist in real-time decision support, providing recommendations based on evidence-based guidelines and clinical

expertise. Virtual cardiology services enhance access to specialized care, particularly for patients in rural or underserved areas, improving patient outcomes and reducing healthcare disparities.

Integration with Imaging Modalities

AI algorithms can be integrated with imaging modalities, such as echocardiography and cardiac MRI, to enhance diagnostic accuracy and efficiency. Deep learning algorithms can analyze imaging data, detect subtle abnormalities, and assist in the early detection of cardiac diseases. AI-powered image analysis can reduce interpretation variability, improve diagnostic confidence, and aid in treatment planning and monitoring.

Medication Adherence and Remote Medication Management

AI-powered telemedicine platforms can improve medication adherence and remote medication management for cardiac patients. AI algorithms can provide medication reminders, monitor medication intake, and detect non-adherence patterns. Real-time adherence feedback and personalized interventions can enhance patient compliance, leading to better control of cardiac conditions and improved treatment outcomes.

Ethical Considerations

and Patient Privacy

As AI integration in telemedicine becomes more prevalent, ethical considerations related to patient privacy, data security, and algorithm transparency need to be addressed. Healthcare providers must ensure that patient data is protected, and AI algorithms are developed and implemented with strict adherence to ethical guidelines. Transparency in AI decision-making processes is crucial to maintain patient trust and confidence in telemedicine solutions.

Challenges and Limitations

Integrating AI into telemedicine for cardiac disease management faces several challenges. Data interoperability, standardization, and integration with existing electronic health record (EHR) systems are important considerations for seamless data exchange. The validation and regulatory approval of AI algorithms and telemedicine platforms are essential to ensure their safety, effectiveness, and compliance with regulatory frameworks. Additionally, healthcare provider training and education on AI technologies are crucial for successful implementation and utilization.

Future Directions

The future of integrating AI into telemedicine for cardiac disease management holds tremendous

potential. Advancements in AI technologies, such as explainable AI and federated learning, can address the interpretability and privacy concerns associated with AI algorithms. Integration with emerging technologies, such as Internet of Things (IoT) devices and remote monitoring systems, can further enhance the capabilities of AI-powered telemedicine. Collaborative efforts between researchers, healthcare providers, technology developers, and regulatory bodies are essential to drive innovation, establish standards, and ensure the responsible and ethical use of AI in cardiac telemedicine.

Heart failure (HF) is one of the most prevalent cardiovascular diseases, associated with a significant burden of symptoms and high morbidity and mortality. It is a significant public health problem, affecting over 26 million adults worldwide. Although advancements have been made in the treatment of chronic HF, the rate of heart disease and death among individuals with HF is very high. This high prevalence is mainly due to the aging population, as the incidence of HF increases exponentially with age. Notably, the complexity of the disease is also increasing, and the majority of HF patients suffer from multiple comorbidities. Therefore, HF is characterized by high morbidity and mortality, and the prognosis has only modestly improved despite treatment advancements. The high event rate, particularly

repeated hospitalizations, is the main cause of the substantial costs and significant impairment of quality of life. It also poses a significant economic burden on healthcare systems, with recent estimates from the U.S. indicating annual costs exceeding $70 billion associated with HF treatment. As the global population ages, HF will remain a significant problem, requiring concerted efforts to optimize treatment strategies, improve clinical outcomes, and minimize the associated economic burden.

One strategy used to complement conventional medicine in managing chronic conditions like HF, particularly to reduce the likelihood of hospital readmissions, is telemedicine. Previous studies comparing usual care with various telemedicine interventions have shown that telemedicine significantly reduces all-cause mortality and hospitalizations related to heart failure. Consequently, telemedicine has emerged as a potential means of reducing the likelihood of worsening heart disease or the prospect of repeated and lengthy hospitalizations. The term "telemedicine" was coined by Strehle and Shabde in the 1970s to mean "healing at a distance." Telemedicine, or telehealth, involves the use of health information through interactive digital communication to enable and optimize the care process, improve patient health through remote consultations, medical examinations,

interventions, and collaboration among medical professionals. The primary goals of telemedicine are to bridge the gap between accessibility and communication in the medical field, reduce delays, and minimize logistical costs.

Telemedicine for chronic diseases like HF is rapidly evolving, allowing for more flexible and frequent monitoring of patient status, reducing financial costs, and enabling safe HF care for patients. Until recently, digital applications in medicine were limited to the use of electronic health records. However, recent technological advancements have significantly expanded the scope. The continuous growth of technology, including expanded internet connectivity, increased data processing capabilities, and the emergence of information sharing, data analytics, the Internet of Things, wearables, cloud technology, and robotics, has created greater opportunities for the development of the global health industry, particularly telemedicine.

In this context, artificial intelligence (AI) can play a significant role in the use and delivery of telemedicine. AI involves the use of algorithms and software that exhibit human-like cognition in analyzing, interpreting, and understanding complex data. Although the concept of AI was introduced over 60 years ago, rapid development in AI-based technology and applications occurred after the improvement of graphics processors

in the 2010s. AI can be applied to various aspects of healthcare, such as providing analysis systems for medical data, identifying sources of errors, developing solutions based on procedure results, and improving processes by integrating computerized intelligence into health devices and tools. The ability to quickly and accurately identify patterns is a significant advantage for determining best practices and making informed decisions in medical procedures. Identifying patterns in medical procedure outputs can optimize and predict future problems. Machine learning, including deep learning and neural networks, is a subset of AI that uses machines to gather information from data. Algorithms need training for information processing to occur. They have the potential to enhance the usefulness of increasing volumes and ranges of longitudinal data. Some types of machine-learning techniques can train computers using properly documented and labeled massive datasets, enabling them to establish independent rules. This helps computers classify and interpret new information, similar to how they process training data. As a result, automated decision support systems have been developed to facilitate diagnosis and prognosis estimation. These systems allow for a streamlined overview of patients' problems that require doctors' attention and enable fast aggregation of data from Patient Electronic Health Records obtained from multiple sources. AI systems

can conduct thorough searches of individual or multiple patients' electronic health records to identify similar patients and evaluate their diagnosis and treatment response, as well as cross-reference data related to the patient's family history.

Conclusion

Integrating Artificial Intelligence into telemedicine for the management of cardiac diseases is a transformative approach that holds great promise. By enabling remote monitoring, improving diagnostic accuracy, facilitating personalized treatment plans, and enhancing medication management, AI-powered telemedicine can revolutionize cardiac care. However, challenges related to data privacy, regulatory compliance, and algorithm transparency must be addressed to ensure patient trust and successful implementation. With continued research, collaboration, and advancements in AI technologies, the future of cardiac telemedicine looks promising, offering improved patient outcomes, increased accessibility to specialized care, and better management of cardiac diseases on a global scale.

5- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF DERMATOLOGICAL DISEASES

Introduction

Dermatological diseases, ranging from common skin conditions to complex dermatoses, pose significant challenges in diagnosis and management. The integration of Artificial Intelligence (AI) into telemedicine offers a promising approach to enhance dermatological disease management by enabling remote consultations, improving diagnostic accuracy, and facilitating personalized treatment plans. This article explores the applications of AI in telemedicine specifically for the management of dermatological diseases, highlighting its benefits, challenges, and future prospects.

Teleconsultation and Remote Dermatology Services

AI-powered teleconsultation platforms enable dermatologists to remotely evaluate and diagnose skin conditions through secure video conferencing. Patients can securely upload images or videos of their skin lesions, enabling dermatologists to assess the condition

remotely. AI algorithms can assist in real-time decision support, providing recommendations based on image analysis and clinical databases. Teleconsultation services improve access to dermatological care, particularly for patients in remote or underserved areas.

Automated Image Analysis and Diagnosis

AI algorithms can analyze images of skin lesions with high precision and efficiency, aiding in the diagnosis of dermatological diseases. Deep learning techniques, such as convolutional neural networks (CNNs), can detect patterns and features in skin images, enabling automated lesion classification and recognition. AI-powered image analysis can provide dermatologists with additional insights, assisting in differential diagnosis and treatment planning.

Skin Cancer Detection and Melanoma Screening

AI algorithms can play a crucial role in the early detection of skin cancer, including melanoma. By analyzing images of skin lesions, AI systems can detect suspicious features, such as asymmetry, irregular borders, and color variations. AI-powered screening tools can assist in triaging patients, identifying those at higher risk for skin cancer and facilitating prompt referrals

for further evaluation. Early detection of skin cancer through AI-powered telemedicine can lead to better treatment outcomes and reduced morbidity.

Personalized Treatment Plans

AI algorithms can assist in developing personalized treatment plans for dermatological diseases. By analyzing patient data, such as medical history, genetic information, and treatment responses, AI can provide insights into optimal treatment strategies tailored to individual patients. This personalized approach improves treatment efficacy, enhances patient adherence, and reduces the risk of adverse reactions. AI-powered telemedicine enables dermatologists to remotely monitor treatment progress, adjust therapies, and provide ongoing support.

Virtual Dermoscopy and Teledermoscopy

Dermoscopy, a non-invasive technique for examining skin lesions, can be performed remotely through AI-powered teledermoscopy. Digital dermoscopy images can be captured by patients using specialized devices or smartphone attachments. AI algorithms can analyze these images, assisting dermatologists in diagnosing and monitoring skin lesions. Teledermoscopy enables early detection of melanoma and

facilitates the longitudinal monitoring of suspicious lesions, reducing unnecessary biopsies and improving patient outcomes.

Dermatopathology and Histopathological Analysis

AI algorithms can aid dermatopathologists in analyzing histopathological images, enhancing diagnostic accuracy and efficiency. Deep learning algorithms can detect and classify specific histological features associated with dermatological diseases, assisting in the interpretation of complex biopsy specimens. AI-powered analysis reduces interobserver variability, improves diagnostic consensus, and streamlines the reporting process.

Patient Education and Self-Care

AI-powered telemedicine platforms can provide educational resources and self-care guidance to patients with dermatological diseases. AI algorithms can deliver personalized educational materials, including videos, articles, and interactive tools, tailored to patients' specific conditions. Telemedicine platforms can also offer virtual follow-up visits, enabling dermatologists to assess treatment responses, reinforce self-care instructions, and address patient concerns remotely.

Challenges and Limitations

Integrating AI into telemedicine for dermatological disease management faces several challenges. The quality and standardization of patient-provided images are crucial for accurate AI analysis. Variability in image quality, lighting conditions, and positioning may affect the performance of AI algorithms. Additionally, ensuring patient privacy, data security, and regulatory compliance is essential when implementing AI-powered telemedicine solutions. Continued research, algorithm refinement, and collaboration between dermatologists, AI developers, and regulatory bodies are necessary to address these challenges.

Ethical Considerations and Patient Trust

As AI integration in telemedicine advances, ethical considerations surrounding patient privacy, data ownership, and algorithm transparency need to be addressed. Patients must have confidence in the security and confidentiality of their medical data when using AI-powered telemedicine platforms. Transparent AI algorithms and clear explanations of AI recommendations are vital to maintain patient trust and foster a strong doctor-patient relationship.

Future Directions

The future of integrating AI into telemedicine for dermatological disease management holds tremendous potential. Advancements in AI technologies, such as explainable AI and federated learning, can address the interpretability and privacy concerns associated with AI algorithms. Integration with emerging technologies, such as augmented reality (AR) or virtual reality (VR), can enhance the remote examination and visualization of skin lesions. Collaborative efforts between researchers, dermatologists, technology developers and regulatory bodies are essential to drive innovation, establish standards, and ensure the responsible and ethical use of AI in dermatological telemedicine.

Automated Triage and Appointment Scheduling

AI algorithms can assist in automating the triage process for dermatological consultations. By analyzing patient-reported symptoms and images, AI systems can prioritize cases based on urgency, severity, and potential diagnosis. This automated triage can help streamline the appointment scheduling process, ensuring that patients with urgent or critical conditions receive prompt attention from dermatologists. AI-powered appointment scheduling systems can optimize the allocation of dermatologists' time

and resources, improving overall efficiency and patient satisfaction.

Telemonitoring of Chronic Dermatological Conditions

For chronic dermatological conditions that require ongoing management, AI-powered telemonitoring can play a crucial role. Patients can use smartphone apps or wearable devices to capture images or data related to their skin condition regularly. AI algorithms can analyze this data, track disease progression, and provide feedback to patients. Dermatologists can remotely monitor treatment responses, adjust medications, and intervene when necessary. Telemonitoring promotes patient engagement, improves treatment adherence, and reduces the need for frequent in-person visits.

AI-Assisted Surgical Planning and Procedures

In cases where dermatological conditions require surgical intervention, AI can assist in surgical planning and procedures. AI algorithms can analyze preoperative images and assist in identifying optimal incision locations, estimating tissue tension, and predicting surgical outcomes. AI-powered surgical guidance systems can provide real-time feedback during procedures, ensuring precision and reducing the risk of complications.

Integrating AI into dermatological surgeries enhances surgical accuracy, improves patient outcomes, and reduces the learning curve for surgeons.

Population Health Management and Epidemiological Surveillance

AI algorithms can analyze large datasets of dermatological images, patient demographics, and environmental factors to identify population-level trends and patterns. This population health management approach can assist public health authorities in monitoring the prevalence of dermatological conditions, identifying high-risk populations, and implementing targeted interventions. AI-powered epidemiological surveillance can enable early detection of disease outbreaks, facilitate resource allocation, and inform public health policies.

AI-Driven Research and Clinical Trials

The integration of AI into telemedicine for dermatological diseases opens avenues for AI-driven research and clinical trials. AI algorithms can analyze massive amounts of patient data, electronic health records, and scientific literature to identify novel associations, treatment responses, and potential therapeutic targets. AI-powered virtual clinical trials can streamline the

research process, reduce costs, and accelerate the development of new dermatological treatments. Telemedicine platforms can facilitate patient recruitment, data collection, and remote study participation, enhancing the efficiency and inclusivity of clinical trials.

Education and Training for Dermatologists

AI can support dermatologists' education and training by providing access to vast amounts of medical literature, case studies, and diagnostic resources. AI-powered virtual learning platforms can deliver interactive educational modules, simulating real-world dermatological scenarios and providing instant feedback. AI algorithms can assist in dermatology residency training programs by offering decision support and guidance during the learning process. AI-driven education and training enhance dermatologists' knowledge, diagnostic skills, and confidence in managing complex dermatological conditions.

Integration with Telepathology and Telehistopathology

Integrating AI with telepathology and telehistopathology can revolutionize dermatological diagnostics. AI algorithms can analyze digitized histopathological slides, assisting pathologists in

diagnosing dermatological conditions accurately. Telepathology enables remote access to expert opinions, reducing the need for physical slide transportation and facilitating timely consultations. AI-powered image analysis in telepathology improves diagnostic accuracy, speeds up the reporting process, and enhances collaboration between dermatologists and pathologists.

Regulatory and Legal Considerations

The integration of AI into telemedicine for dermatological disease management necessitates attention to regulatory and legal considerations. Regulatory bodies must establish guidelines for the development, validation, and safety assessment of AI algorithms used in dermatology. Legal frameworks need to address issues related to liability, malpractice, and patient consent in AI-powered telemedicine. Ensuring transparency, accountability, and adherence to ethical standards are crucial for maintaining patient trust and the responsible use of AI in dermatological telemedicine.

Collaboration and Interdisciplinary Approaches

The successful integration of AI into telemedicine for dermatological diseases requires

collaboration between dermatologists, AI experts, engineers, and other healthcare professionals. Interdisciplinary teams can work together to develop robust AI algorithms, validate their performance, and address specific dermatological challenges. Collaborative efforts foster innovation, knowledge exchange, and the development of comprehensive solutions that align with the needs of dermatologists and patients.

Conclusion

Integrating Artificial Intelligence into telemedicine for the management of dermatological diseases offers numerous benefits, including improved access to care, enhanced diagnostic accuracy, and personalized treatment plans. AI-powered teleconsultation, image analysis, and decision support systems can assist dermatologists in diagnosing skin conditions, detecting skin cancer, and developing tailored treatment strategies. However, challenges related to image quality, data privacy, and algorithm transparency must be addressed to ensure the successful implementation and widespread adoption of AI in dermatological telemedicine. With continued advancements in AI technology, collaboration, and regulatory frameworks, the future of dermatological telemedicine looks promising, offering improved patient outcomes, increased accessibility to specialized care, and more effective management of dermatological

diseases on a global scale.

6- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF OPHTHALMOLOGICAL DISEASES

Introduction

Ophthalmological diseases, ranging from common vision disorders to complex retinal conditions, pose significant challenges in diagnosis and management. The integration of Artificial Intelligence (AI) into telemedicine offers a promising approach to enhance ophthalmological disease management by enabling remote consultations, improving diagnostic accuracy, and facilitating personalized treatment plans. This article explores the applications of AI in telemedicine specifically for the management of ophthalmological diseases, highlighting its benefits, challenges, and future prospects.

Teleconsultation and Remote Ophthalmology Services

AI-powered teleconsultation platforms enable ophthalmologists to remotely evaluate and diagnose eye conditions through secure video conferencing. Patients can securely upload images

or videos of their eyes, enabling ophthalmologists to assess the condition remotely. AI algorithms can assist in real-time decision support, providing recommendations based on image analysis, clinical databases, and patient history. Teleconsultation services improve access to ophthalmological care, particularly for patients in remote or underserved areas.

Automated Image Analysis and Diagnostics

AI algorithms can analyze images of the eye with high precision and efficiency, aiding in the diagnosis of ophthalmological diseases. Deep learning techniques, such as convolutional neural networks (CNNs), can detect patterns and features in retinal images, enabling automated disease detection and recognition. AI-powered image analysis can provide ophthalmologists with additional insights, assisting in the identification of conditions such as diabetic retinopathy, age-related macular degeneration, and glaucoma.

Early Detection of Eye Diseases

AI algorithms can play a crucial role in the early detection of eye diseases by analyzing retinal images or optical coherence tomography (OCT) scans. AI systems can identify subtle changes in the retina or optic nerve that may indicate the presence of conditions such as glaucoma

or diabetic retinopathy. Early detection through AI-powered telemedicine allows for timely intervention and treatment, reducing the risk of vision loss and improving patient outcomes.

Personalized Treatment Plans

AI algorithms can assist in developing personalized treatment plans for ophthalmological diseases. By analyzing patient data, such as medical history, genetic information, and treatment responses, AI can provide insights into optimal treatment strategies tailored to individual patients. This personalized approach improves treatment efficacy, enhances patient adherence, and reduces the risk of adverse reactions. AI-powered telemedicine enables ophthalmologists to remotely monitor treatment progress, adjust therapies, and provide ongoing support.

Teleophthalmology Screening Programs

AI-powered teleophthalmology screening programs can effectively identify individuals at risk of developing ophthalmological diseases. Screening platforms can leverage AI algorithms to analyze retinal images or perform visual field tests remotely. AI systems can detect early signs of conditions like diabetic retinopathy, enabling timely referrals for further evaluation

and treatment. Teleophthalmology screening programs are particularly beneficial in resource-limited settings, where access to ophthalmologists is limited.

AI-Guided Surgery and Surgical Planning

AI algorithms can assist ophthalmologists in surgical planning and procedures. By analyzing preoperative images, AI systems can provide guidance on optimal incision locations, intraocular lens selection, and surgical techniques. AI-powered surgical guidance systems can offer real-time feedback during procedures, ensuring precision and reducing the risk of complications. Integrating AI into ophthalmological surgeries enhances surgical accuracy, improves patient outcomes, and facilitates the sharing of expertise through remote assistance.

Monitoring of Chronic Eye Conditions

For chronic eye conditions that require ongoing management, AI-powered telemonitoring can be invaluable. Patients can use smartphone apps or wearable devices to capture images or data related to their eyes regularly. AI algorithms can analyze this data, track disease progression, and provide feedback to patients. Ophthalmologists can remotely monitor treatment responses, adjust

medications, and intervene when necessary. Telemonitoring promotes patient engagement, improves treatment adherence, and reduces the need for frequent in-person visits.

AI-Assisted Refractive Surgery Planning

AI algorithms can assist in refractive surgery planning by analyzing patient data and corneal topography images. AI systems can predict the optimal surgical parameters, such as the depth and diameter of incisions, to achieve the desired visual outcome. By leveraging AI in refractive surgery planning, ophthalmologists can improve surgical accuracy, reduce postoperative complications, and enhance patient satisfaction.

Education and Training for Ophthalmologists

AI can support ophthalmologists' education and training by providing access to vast amounts of medical literature, case studies, and diagnostic resources. AI-powered virtual learning platforms can deliver interactive educational modules, simulating real-world ophthalmological scenarios and providing instant feedback. AI algorithms can assist in ophthalmology residency training programs by offering decision support and guidance during the learning process. AI-driven education and training enhance ophthalmologists'

knowledge, diagnostic skills, and confidence in managing complex eye conditions.

Challenges and Limitations

Integrating AI into telemedicine for ophthalmological disease management faces several challenges. Image quality, standardization, and variations in imaging devices can affect thereliability of AI algorithms. Additionally, data privacy and security concerns must be addressed to ensure patient confidentiality. Regulatory frameworks should be developed to validate AI algorithms, establish guidelines for their use, and ensure ethical practices. Moreover, the need for specialized hardware and technical expertise may pose barriers to widespread adoption, particularly in resource-limited settings.

Future Prospects

Despite the challenges, the future prospects of integrating AI into telemedicine for ophthalmological diseases are promising. Advancements in AI algorithms, computer vision, and machine learning techniques will continue to enhance the accuracy and efficiency of diagnostic tools. Collaborative efforts between ophthalmologists, AI experts, and engineers will drive innovation and the development of comprehensive solutions. The integration of AI with emerging technologies such as virtual

reality and augmented reality may further revolutionize telemedicine by enabling immersive ophthalmological examinations and surgical simulations.

Regulatory Considerations

Regulatory bodies need to establish guidelines for the development, validation, and safe use of AI algorithms in ophthalmological telemedicine. Transparent and accountable practices, as well as adherence to ethical standards, are essential to build patient trust and ensure responsible AI implementation. Regulatory frameworks should address issues related to liability, malpractice, and patient consent in AI-powered telemedicine.

Conclusion

Integrating Artificial Intelligence into telemedicine for the management of ophthalmological diseases holds great promise for improving patient care, diagnostic accuracy, and treatment outcomes. AI-powered teleconsultation, image analysis, screening programs, and surgical planning enhance the accessibility and efficiency of ophthalmological care. Collaboration between ophthalmologists, AI experts, engineers, and other healthcare professionals is crucial for developing robust AI algorithms, validating their performance, and addressing specific challenges in ophthalmology.

With continued advancements in AI technologies, interdisciplinary research, and regulatory frameworks, AI has the potential to transform ophthalmological telemedicine, leading to better patient outcomes, increased efficiency, and more personalized care. By leveraging the power of AI, ophthalmologists can provide high-quality eye care remotely, reaching patients in underserved areas and revolutionizing the management of ophthalmological diseases on a global scale.

7- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF ORAL DISEASES

Introduction

Oral diseases, including dental caries, periodontal diseases, and oral cancers, are prevalent worldwide and pose significant challenges in diagnosis and management. The integration of Artificial Intelligence (AI) into telemedicine offers a promising approach to enhance the management of oral diseases by enabling remote consultations, improving diagnostic accuracy, and facilitating personalized treatment plans. This article explores the applications of AI in telemedicine specifically for the management of oral diseases, highlighting its benefits, challenges, and future prospects.

Integrating AI into telemedicine for the management of oral diseases has the potential to revolutionize dental care and improve patient outcomes. AI technologies can assist in various aspects of oral disease management, including diagnosis, treatment planning, monitoring, and patient education.

One area where AI can make a significant impact

is in the diagnosis of oral diseases. By training AI algorithms on large datasets of annotated images, they can learn to identify patterns, anomalies, and specific conditions with high accuracy. For example, AI models can analyze oral images such as X-rays, intraoral scans, and photographs to aid in the diagnosis of conditions like cavities, gum disease, or oral cancer. In addition to diagnosis, AI can also play a crucial role in treatment planning. By considering various factors such as the patient's medical history, oral condition, and treatment objectives, AI algorithms can assist in developing personalized treatment plans. Machine learning algorithms can analyze vast amounts of data from similar cases and provide evidence-based recommendations.

Telemedicine combined with AI enables continuous monitoring of patients' oral health remotely. AI-powered systems can analyze real-time data from wearable devices or imaging modalities, tracking changes in oral conditions and identifying potential issues before they escalate. For example, AI algorithms can monitor changes in gum health, tooth movement after orthodontic treatment, or the effectiveness of dental implants. Predictive analytics algorithms can also analyze historical patient data to anticipate disease progression and enable proactive interventions, preventing complications and reducing the need for emergency dental visits.

Virtual consultations powered by AI chatbots and virtual assistants can facilitate remote interactions between dentists and patients. These conversational AI systems can provide basic information, answer patient inquiries, offer oral hygiene instructions, and triage cases based on urgency.

Furthermore, integrating AI into telemedicine for oral disease management can contribute to data analysis and research. AI can process electronic health records (EHRs), clinical notes, and research papers using natural language processing algorithms. This enables researchers and policymakers to identify trends, patterns, and potential treatment outcomes on a large scale. By leveraging AI's data analysis capabilities, evidence-based guidelines can be developed, leading to improved healthcare practices and policies. However, several challenges exist in integrating AI into telemedicine for oral disease management. Ensuring patient privacy and data security is of utmost importance. Robust measures must be in place to protect sensitive patient information and comply with regulatory requirements. Addressing algorithm biases is another challenge, as AI models should be trained on diverse datasets that represent different populations to avoid biased decision-making.

In conclusion, integrating AI into telemedicine for managing oral diseases has the potential

to transform dental care. By leveraging AI's capabilities in diagnosis, treatment planning, monitoring, patient education, and research, dental professionals can provide more accurate, personalized, and accessible care. However, it is essential to address challenges related to privacy, bias, and regulation to ensure ethical and responsible use of AI in oral disease management. With continued advancements and collaboration between human expertise and AI technologies, the future of telemedicine in dentistry looks promising.

Teleconsultation and Remote Dental Services

AI-powered teleconsultation platforms enable dentists to remotely evaluate and diagnose oral conditions through secure video conferencing. Patients can securely upload images or videos of their oral cavity, allowing dentists to assess the condition remotely. AI algorithms can assist in real-time decision support, providing recommendations based on image analysis, clinical databases, and patient history. Teleconsultation services improve access to dental care, particularly for patients in remote or underserved areas.

Automated Image Analysis and Diagnostics

AI algorithms can analyze images of the oral cavity with high precision and efficiency, aiding in the diagnosis of oral diseases. Deep learning techniques, such as convolutional neural networks (CNNs), can detect patterns and features in oral images, enabling automated disease detection and recognition. AI-powered image analysis can provide dentists with additional insights, assisting in the identification of conditions such as dental caries, periodontal diseases, and oral cancers.

Early Detection of Oral Diseases

AI algorithms can play a crucial role in the early detection of oral diseases by analyzing oral images or radiographs. AI systems can identify subtle changes in the oral cavity that may indicate the presence of conditions such as oral cancer or precancerous lesions. Early detection through AI-powered telemedicine allows for timely intervention and treatment, reducing the risk of disease progression and improving patient outcomes.

Personalized Treatment Plans

AI algorithms can assist in developing personalized treatment plans for oral diseases. By analyzing patient data, such as medical history, genetic information, and treatment responses, AI can provide insights into optimal

treatment strategies tailored to individual patients. This personalized approach improves treatment efficacy, enhances patient adherence, and reduces the risk of complications. AI-powered telemedicine enables dentists to remotely monitor treatment progress, adjust therapies, and provide ongoing support.

Tele-dentistry Screening Programs

AI-powered tele-dentistry screening programs can effectively identify individuals at risk of developing oral diseases. Screening platforms can leverage AI algorithms to analyze oral images or patient-reported symptoms remotely. AI systems can detect early signs of conditions like oral cancer or periodontal diseases, enabling timely referrals for further evaluation and treatment. Tele-dentistry screening programs are particularly beneficial in resource-limited settings, where access to dentists is limited.

AI-Guided Oral Surgery and Treatment Planning

AI algorithms can assist dentists in oral surgery planning and procedures. By analyzing patient data, such as radiographs and 3D scans, AI systems can provide guidance on optimal treatment plans, implant positioning, and surgical techniques. AI-powered surgical guidance systems can offer

real-time feedback during procedures, ensuring precision and reducing the risk of complications. Integrating AI into oral surgeries enhances surgical accuracy, improves patient outcomes, and facilitates the sharing of expertise through remote assistance.

Monitoring of Oral Conditions

For chronic oral conditions that require ongoing management, AI-powered telemonitoring can be invaluable. Patients can use smartphone apps or wearable devices to capture images or data related to their oral health regularly. AI algorithms can analyze this data, track disease progression, and provide feedback to patients. Dentists can remotely monitor treatment responses, adjust medications, and intervene when necessary. Telemonitoring promotes patient engagement, improves treatment adherence, and reduces the need for frequent in-person visits.

AI-Assisted Dental Implant Planning

AI algorithms can assist dentists in dental implant planning by analyzing patient data, such as 3D scans and bone density measurements. AI systems can predict the optimal implant size, position, and angulation to achieve the best functional and aesthetic results. By leveraging AI in dental implant planning, dentists can improve treatment

accuracy, reduce surgical complications, and enhance patient satisfaction.

Education and Training for Dentists

AI can support dentists' education and training by providing access to vast amounts of dental literature, case studies, and diagnostic resources. AI-powered virtual learning platforms can deliver interactive educational modules, simulating real-world dental scenarios and providing instant feedback. AI algorithms can assist in dental residency training programs by offering decision support and guidance during the learning process. AI-driven education and training enhance dentists' knowledge, diagnostic skills, and confidence in managing complex oral diseases.

Challenges and Limitations

Integrating AI into telemedicine for the management of oral diseases faces several challenges. Image quality, standardization, and variations in imaging devices can affect the reliability of AI algorithms. Additionally, data privacy and security concerns must be addressed to ensure patient confidentiality. Regulatory frameworks should be developed to validate AI algorithms, establish guidelinesfor their use, and ensure ethical considerations. The integration of AI into telemedicine also requires adequate

infrastructure, including high-speed internet connectivity and reliable telecommunication systems, which may be limited in certain regions.

Future Prospects

Despite the challenges, the future prospects of integrating AI into telemedicine for oral disease management are promising. Advancements in AI algorithms, coupled with the increasing availability of digital oral health data, will further improve diagnostic accuracy and treatment outcomes. As AI algorithms continue to learn from large-scale datasets, their performance will enhance, enabling more precise disease detection and personalized treatment recommendations. Collaborative efforts between dental professionals, AI researchers, and regulatory bodies are necessary to drive innovation, standardize AI applications, and ensure their seamless integration into telemedicine platforms.

Conclusion

The integration of Artificial Intelligence into telemedicine has the potential to revolutionize the management of oral diseases. AI-powered teleconsultation, automated image analysis, early disease detection, personalized treatment planning, tele-dentistry screening programs, AI-guided oral surgery, and telemonitoring are some of the key applications that can significantly

enhance oral healthcare delivery. While challenges exist, continued research, development, and collaboration will pave the way for the widespread adoption of AI in telemedicine, ultimately improving patient access, diagnostic accuracy, and treatment outcomes in the field of oral healthcare.

8- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF ENT DISEASES

Introduction

Ear, Nose, and Throat (ENT) diseases encompass a wide range of conditions, including hearing loss, sinusitis, tonsillitis, and vocal cord disorders. The integration of Artificial Intelligence (AI) into telemedicine offers a promising approach to enhance the management of ENT diseases by enabling remote consultations, improving diagnostic accuracy, and facilitating personalized treatment plans. This article explores the applications of AI in telemedicine specifically for the management of ENT diseases, highlighting its benefits, challenges, and future prospects.

Teleconsultation and Remote ENT Services

AI-powered teleconsultation platforms enable ENT specialists to remotely evaluate and diagnose patients with ENT conditions through secure video conferencing. Patients can securely upload images or videos of their ears, nose, or throat, allowing specialists to assess the condition remotely. AI algorithms can assist in real-time

decision support, providing recommendations based on image analysis, clinical databases, and patient history. Teleconsultation services improve access to ENT care, particularly for patients in remote or underserved areas.

Automated Image Analysis and Diagnostics

AI algorithms can analyze images or scans of the ears, nose, and throat with high precision and efficiency, aiding in the diagnosis of ENT diseases. Deep learning techniques, such as convolutional neural networks (CNNs) and computer vision algorithms, can detect patterns and features in medical images, enabling automated disease detection and recognition. AI-powered image analysis can provide ENT specialists with additional insights, assisting in the identification of conditions such as ear infections, nasal polyps, and vocal cord abnormalities.

Early Detection of ENT Diseases

AI algorithms can play a crucial role in the early detection of ENT diseases by analyzing images, scans, or patient-reported symptoms. AI systems can identify subtle changes in the ears, nose, and throat that may indicate the presence of conditions such as tumors, infections, or structural abnormalities. Early detection through AI-powered telemedicine allows for timely

intervention and treatment, reducing the risk of disease progression and improving patient outcomes.

Personalized Treatment Plans

AI algorithms can assist in developing personalized treatment plans for ENT diseases. By analyzing patient data, such as medical history, genetic information, and treatment responses, AI can provide insights into optimal treatment strategies tailored to individual patients. This personalized approach improves treatment efficacy, enhances patient adherence, and reduces the risk of complications. AI-powered telemedicine enables ENT specialists to remotely monitor treatment progress, adjust therapies, and provide ongoing support.

Tele-otolaryngology Screening Programs

AI-powered tele-otolaryngology screening programs can effectively identify individuals at risk of developing ENT diseases. Screening platforms can leverage AI algorithms to analyze patient-reported symptoms, medical history, or images of the ears, nose, and throat remotely. AI systems can detect early signs of conditions like throat cancer, hearing loss, or chronic sinusitis, enabling timely referrals for further evaluation and treatment. Tele-otolaryngology screening

programs are particularly beneficial in resource-limited settings, where access to ENT specialists is limited.

AI-Guided ENT Surgery and Treatment Planning

AI algorithms can assist ENT specialists in surgery planning and procedures. By analyzing patient data, such as radiographs, CT scans, or endoscopic images, AI systems can provide guidance on optimal treatment plans, surgical techniques, and implant positioning. AI-powered surgical guidance systems can offer real-time feedback during procedures, ensuring precision and reducing the risk of complications. Integrating AI into ENT surgeries enhances surgical accuracy, improves patient outcomes, and facilitates the sharing of expertise through remote assistance.

Monitoring of ENT Conditions

For chronic ENT conditions that require ongoing management, AI-powered telemonitoring can be invaluable. Patients can use smartphone apps or wearable devices to capture images or data related to their ENT health regularly. AI algorithms can analyze this data, track disease progression, and provide feedback to patients. ENT specialists can remotely monitor treatment responses, adjust medications, and intervene when necessary. Telemonitoring promotes patient engagement,

improves treatment adherence, and reduces the need for frequent in-person visits.

AI-Assisted Hearing Aid Fitting

AI algorithms can assist in the fitting and customization of hearing aids for patients with hearing loss. By analyzing audiometric data, patient preferences, and environmental factors, AI systems can optimize hearing aid settings to provide personalized sound amplification. AI-powered hearing aid fitting ensures better speech understanding, sound quality, and patient satisfaction. Remote adjustments and fine-tuning can be done through telemedicine, reducing the need for in-person visits.

Education and Training for ENT Specialists

AI can support the education and training of ENT specialists by providing access to vast amounts of medical literature, case studies, and diagnostic resources. AI-powered virtual learning platforms can deliver interactive educational modules, simulating real-world ENT scenarios and providing instant feedback. AI algorithms can assist in residency training programs by offering decision support and guidance during the learning process. AI-driven education and training enhance ENT specialists' knowledge, diagnostic skills, and confidence in managing complex ENT diseases.

Challenges and Limitations

Integrating AI into telemedicine for the management of ENT diseases faces several challenges. Image quality, standardization, and variations in imaging devices can affect the reliability of AI algorithms. Additionally, data privacy and security concerns must be addressed to ensure patient confidentiality. Regulatory frameworks should be developed to validate AI algorithms, establish guidelines for their use, and ensure ethical considerations. The integration of AI into telemedicine also requires adequate infrastructure, including high-speed internet connectivity and reliable telecommunication systems, which may be limited in certain regions.

Future Prospects

Despite the challenges, the future prospects of integrating AI into telemedicine for the management of ENT diseases are promising. Advancements in AI algorithms, coupled with the increasing availability of digital ENT health data, will further improve diagnostic accuracy and treatment outcomes. As AI algorithms continue to learn from large-scale datasets, their performance will enhance, enabling more precise disease detection and personalized treatment recommendations. Collaborative efforts between ENT specialists, AI researchers, and regulatory bodies are necessary to drive innovation,

standardize AI applications, and ensure their seamless integration into telemedicine platforms.

Conclusion

The integration of Artificial Intelligence into telemedicine has the potential to revolutionize the management of ENT diseases. AI-powered teleconsultation, automated image analysis, early disease detection, personalized treatment planning, tele-otolaryngology screening programs, AI-guided ENT surgery, and telemonitoring are some of the key applications that can significantly enhance ENT healthcare delivery. While challenges exist, continued research, development, and collaboration will pave the way for the widespread adoption of AI in telemedicine, ultimately improving patient access, diagnostic accuracy, and treatment outcomes in the field of ENT healthcare.

9- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF ORTHOPEDIC DISEASES

Telemedicine offers secure, high-quality, and efficient approaches to providing healthcare services. By utilizing teleconsultations in the Covid era, healthcare professionals were able to maintain a satisfactory level of medical services while prioritizing the safety of both patients and physicians. Although there is inconclusive evidence regarding the efficacy of telemedicine in achieving precise diagnoses, the majority of research indicates a positive correlation.

Telemedicine is quickly changing in different medical fields, such as orthopedics. When utilized for general orthopedic outpatient clinics, telemedicine proves to have remarkable satisfaction rates, according to both patients and orthopedic surgeons. Telemedicine can effectively handle a significant portion of patient visits to outpatient departments, thus reducing the physical burden on hospitals. Many hospitals face a scarcity of experienced radiologists with specialized orthopedic training, particularly during nighttime shifts. Factors such as fatigue, lack of experience, and time constraints when interpreting diagnostic images contribute to an

increased risk of human errors, which can lead to misdiagnosis.

Artificial Intelligence (AI) technologies have quickly become a regular part of our daily lives, and examples of AI intervention in our everyday routines have been prevalent. The integration of AI in the medical field has been extensively predicted ever since John McCarthy initially introduced the concept more than six decades ago. The potential of AI to revolutionize the field of medicine lies in its ability to automate tasks and its promising performance in diverse medical applications, including predicting the risk of future injuries, interpreting medical imaging, assessing patient-reported outcomes, generating value-based metrics, and enhancing telemedicine consultations.

AI has found various applications in the field of orthopedics, offering a wide range of benefits and possibilities. The strong ability of AI to recognize patterns makes it well-suited for the automated interpretation of medical imaging. In a study about the use of Artificial Intelligence and Machine Learning (ML) in five key orthopedic disciplines, it was emphasized the potential of AI and ML to enhance the accuracy and efficiency of interpreting radiological imaging. AI and ML are employed to swiftly analyze imaging modalities such as X-rays and MRIs, aiding evidence-based decision-making by identifying risk factors

for complications or other significant outcomes. The use of computer technology to interpret radiographs can be beneficial in two ways: firstly, it may assist clinicians in accurately evaluating the initial fracture, and secondly, it may offer a means of reviewing a significant number of fractures to determine the most effective treatment approach. As a way of illustration, AI has the ability to accurately recognize and classify fractures of the proximal humerus based on plain shoulder anteroposterior radiographs.

When faced with an unfamiliar image, an algorithm can analyze the imaging data and provide a decision based on the given query, offering valuable support. AI can aid in determining the appropriateness of imaging orders and assist in identifying patients who are at a higher risk of fractures. AI has demonstrated comparable diagnostic capabilities to human experts and outperformed non-expert human readers in fracture diagnosis. By enhancing image quality, prioritizing patient-centered care, improving imaging efficiency, and boosting diagnostic accuracy, AI has the potential to greatly enhance the value that musculoskeletal imagers bring to both patients and referring clinicians.

AI technology has the potential to aid orthopedic doctors during the diagnostic phase to detect various conditions at an earlier stage, develop new treatments more quickly, and closely monitor

patients before and after surgeries. AI and ML are leveraged for remote patient monitoring, allowing clinicians to intervene and modify treatment plans to positively influence clinical and surgical outcomes, transforming undesired results into beneficial ones.

The field of orthopedics is utilizing AI in several other ways apart from the ones already mentioned. AI-assisted follow-up systems have demonstrated to be as effective as manual follow-up approaches. Additionally, the incorporation of AI technology has been discovered to be advantageous in minimizing the expenses related to human resources involved in hospital ward management. AI holds the potential to bring about positive changes in orthopedics by addressing the growing demands of repetitive tasks that lead to physician burnout and medical errors. Moreover, the field of orthopedics can derive advantages by using AI and ML to enhance patient care and gain valuable insights into different features of musculoskeletal treatment.

The implementation of AI technology in orthopedic surgery is currently limited to certain clinical settings, but it is anticipated to become more widespread in the coming years. The slow adoption of AI in orthopedic surgery can be attributed to an insufficient understanding of computing power and the intricate nature of interacting with human tissue. Nonetheless, AI is

progressing rapidly, and its purpose is to assist medical professionals rather than replace them in this domain. Constantly evolving computer-assisted solutions are significantly transforming surgical practices. However, it is crucial to reassess future directions, limitations, and potential drawbacks, determining which technologies should be prioritized within the orthopedic community.

Over the last few years, Artificial Intelligence (AI) has rapidly grown all over the world; though widespread understanding of basic principles and compliance of applications remains nascent. The medical industry is searching for novel technologies to monitor patients, as well as increase the efficiency of diagnosis and treatment with the assistance of AI systems. With the help of AI, diagnostic efficiency has improved significantly in areas such as MRI, X-ray, and CT. AI can provide quick results and transform the ineffective traditional medical model, which often fails to deliver timely and accurate conclusions, especially for complicated diagnoses like Coxavalga and Coxavara. Artificial Intelligence, with the help of apps, adds value to the doctor-patient relationship and enhances the workflow in healthcare institutions. The term "app" refers extensively to applications running on mobile devices such as tablets, smartphones, or smartwatches, covering an

extensive range of usability requirements for patients. A primary but efficient functionality of so-called care pathway or patient journey apps is to contain patient-centered information (text, images, and videos), reminders concerning correctly timed medications, nutrition, calendar integration, alerts, and preparations or treatment before procedures, as well as during rehabilitation. Thomas et al. reported that patient education with timely medical knowledge through their tablets or smartphones improves their levels of information, medication and treatment adherence, consent, and clinical outcomes. Furthermore, it has a positive effect on healthcare economics. These effects are more evident in interventions of short duration (less than a month) and with high repetition of messages to patients (once per week or more). In the field of postoperative rehabilitation, AI technology plays a crucial role in the recovery process. For instance, with the gradual diversification of AI technology, there have been many new tools (monitoring and remote management) in the field of nursing. However, applications in the field of orthopedics and rehabilitation, especially movement pattern correction, are still scarce. The application of an AI-assisted follow-up system in orthopedic disease management could have the potential to improve telemedicine follow-up services and patient satisfaction.

A chatbot is one of the modern inventions for remote management and monitoring of patients. It is a computer program or smartphone app based on AI that can communicate with people via auditory or text-based interactions. Medical chatbots have been used in disease diagnosis, management, and monitoring. Integrating chatbots into the telemedicine system could be used to help assess disease conditions and provide self-care recommendations for patients.

10- INTEGRATING ARTIFICIAL INTELLIGENCE INTO TELEMEDICINE FOR MANAGEMENT OF OTHER DISEASES

Integrating Artificial Intelligence into Telemedicine for Management of Cancers

Telemedicine was invented in the 1970s and it means "healing from a distance." However, according to the World Health Organization (WHO), it refers to healthcare delivery when distance is a crucial factor, with all healthcare providers utilizing technology for prevention, diagnosis, and treatment. It is a remote online diagnosing and treating modality provided by healthcare professionals from anywhere. In North America, rural residents often have to travel about three hours to access medical services. The main goals of telemedicine are to ease accessibility to healthcare services and reduce costs and delays by using telecommunication and network services. Several medical specialties have demonstrated the importance of telemedicine in many medical conditions, particularly for cancer patients who are at high risk of death or other complications. Patients with cancer require regular visits and follow-up to assess the progression of their

treatment, which can be challenging for them and their oncologists. Since March 2020, when the WHO officially declared the COVID-19 pandemic, all aspects of healthcare services, including diagnosis, palliative care, treatment, follow-up, and screening, have been affected, and cancer care is no exception. Hence, telemedicine has become even more valuable as it brings safety and satisfaction to cancer patients by allowing them to receive care in their homes, reducing the workload for oncologists and the need for travel to oncology centers.

Providing an ideal diagnosis protocol, particularly for cancer patients, is a multidisciplinary practice that includes history taking, physical examination, clinical imaging, blood tests, and genetic tests. However, certain neuropsychological tests that assess mental health and neurological conditions may be inaccessible or cost-prohibitive in telemedicine setups. This is where Artificial Intelligence (AI) can offer optimal solutions. The innovation of AI and its development and improvement of solutions for specific needs have benefited various healthcare services, including telemedicine.

The term "AI" describes and compares machine intelligence to human intelligence. It was first defined by John McCarthy in 1956 as the science of constructing intelligent machines. Over the past twenty years, the number of scientific publications

in the field of AI has significantly increased, with over 60,000 publications annually. In the biomedical and healthcare fields, the number of publications has increased by more than 8 times since 2000. By 2025, the AI market in healthcare is expected to exceed $20 billion, with an annual growth rate of approximately 50%.

It is clear that the collaboration between physicians and AI has improved, but AI cannot manage patients in the absence of clinicians' input, and it is not expected to completely replace the role of clinicians. While there is a positive outlook on AI in the medical field, some white papers have highlighted the disruptive nature of AI in healthcare services. Moreover, clinicians need to understand and test various aspects of AI settings to identify and mitigate any potential disruptions and side effects. In 2018, the American Medical Association (AMA) adopted a new policy to guide the development and utilization of AI systems, including sensors, storage, and analytic power, in medical settings.

AI applications in the biomedical field have two main aspects: virtual and physical. Both aspects can assist clinicians in providing better quality services for patients. The virtual part includes machine learning and deep learning (a subset of machine learning), while the physical component includes medical devices, robots, and nanorobots used for targeted drug delivery. One valuable

feature of AI that has gained recent attention is image recognition through machine learning algorithms. This feature has a promising future in modern diagnostic imaging and digital pathology, as it can be used as a cost-effective technique for screening and early detection of cancer, ultimately reducing mortality and morbidity rates. These algorithms can be trained to detect patterns using statistical models based on prior data.

Image analysis is not the only beneficial feature of AI, as machine learning in healthcare extends beyond medical image processing. Another clear advantage of AI over humans is its ability to solve analytical problems when dealing with large amounts of data.

In general, AI applications impact telemedicine in four ways: data analysis, intelligent diagnosis, information technology, and patient monitoring. The combination of telemedicine and AI can increase the quality of screening and monitoring, personalize diagnosis, improve the accessibility of oncological and palliative care, and ultimately enhance patient and doctor satisfaction.

History taking plays a crucial role in diagnosis, often more important than physical examination. However, history taking, electronic recording, and data processing consume approximately 50% of a clinician's time. By analyzing prior data and detecting specific patterns, artificial intelligence can provide proper suggestions for the next

questions based on patients' answers, thus helping clinicians save time in a telemedicine setting.

Recently, many start-up companies have developed tele-diagnosing applications that evaluate patients' vital signs, including respiratory rate and pattern, heart rate, and arrhythmia, using non-medical devices like cellphones. When combined with AI, clinicians can evaluate and screen patients through a questionnaire. AI applications can help oncologists monitor and follow up with their patients remotely.

The combination of medical imaging and AI applications in telemedicine has led to several studies evaluating AI-driven image analysis for diagnosing skin cancer. These studies have shown that AI has the same diagnostic accuracy as qualified dermatologists when analyzing datasets containing images. However, there are limitations when it comes to similar-appearing non-skin cancer lesions, which may require a biopsy due to low specificity. This specific condition can lead to misdiagnosis of patients.

In conclusion, telemedicine plays a crucial role in medical care and has been applied to various medical fields, assisting clinicians in remotely managing their patients, especially in the context of cancer care, including screening, prediagnosis, and follow-up. The integration of artificial intelligence into telemedicine brings

about significant changes in healthcare services, particularly in image and data analysis. However, biases and limitations have been observed in this integration. Additionally, a lack of education and information can disrupt the development and utilization of technology. Therefore, there is a need for consistent studying and research on AI, even more than in the past.

Integrating Artificial Intelligence into Telemedicine for Management of Anesthesiology in Operating Room

Artificial intelligence has the potential to revolutionize various aspects of healthcare, including anesthesia management in the operating room. Telemedicine, which involves the remote delivery of healthcare services using telecommunications technology, can be enhanced by the integration of AI to improve the efficiency and effectiveness of anesthesiology procedures. One key area where AI can contribute to telemedicine in anesthesiology is in the prediction and monitoring of patient outcomes. AI algorithms can analyze large datasets of patient information and identify patterns, enabling the prediction of anesthesia-related complications and adverse events. By continuously monitoring various physiological parameters during surgery, AI systems can provide real-time feedback to

anesthesiologists, helping them make decisions and take preventive measures to ensure patient safety.

Furthermore, AI can assist in the automation of routine tasks and decision-making processes, allowing anesthesiologists to focus on more complex aspects of patient care. For example, AI algorithms can help with real-time monitoring of vital signs, adjusting anesthesia levels accordingly, and notifying healthcare professionals of any variations. This can reduce the need for constant manual monitoring and allow anesthesiologists to prioritize critical cases. AI can also facilitate remote collaboration and consultation between anesthesiologists and other healthcare professionals. With the integration of telemedicine, anesthesiologists can remotely connect with experts in real-time, seeking advice or guidance during challenging cases. This can save crucial time and improve patient outcomes by leveraging specialized knowledge and experience regardless of physical location.

In addition, AI can contribute to the standardization of anesthesiology practices. By analyzing vast amounts of patient data, AI algorithms can identify best practices and evidence-based protocols. This can help establish consistent and optimized anesthesia management approaches, ensuring that patients receive high-quality care regardless of their geographical

location. However, it is important to acknowledge certain challenges in integrating AI into telemedicine for anesthesiology. Data privacy and security concerns must be addressed to safeguard patient information shared digitally. Moreover, the implementation of AI technologies requires careful validation and regulatory approval processes to ensure their safety, reliability, and effectiveness.

In conclusion, integrating artificial intelligence into telemedicine for the management of anesthesiology in the operating room holds great promise. AI can assist in predicting and monitoring patient outcomes, automating routine tasks, facilitating remote collaboration, and standardizing anesthesiology practices. While there are challenges to address, the combination of AI and telemedicine has the potential to enhance anesthesia care, improve patient safety, and optimize healthcare delivery worldwide.

REFERENCES

1. Adly AS, Adly AS, Adly MS. Approaches Based on Artificial Intelligence and the Internet of Intelligent Things to Prevent the Spread of COVID-19: Scoping Review. J Med Internet Res. 2020;22(8):e19104.

2. Agarwal P, Kithulegoda N, Umpierre R, Pawlovich J, Pfeil JN, D'Avila OP, et al. Telemedicine in the driver's seat: new role for primary care access in Brazil and Canada: The Besrour Papers: a series on the state of family medicine in Canada and Brazil. Can Fam Physician. 2020;66(2):104-11.

3. Ahmed I, Hoyek S, Patel NA. Global Disparities in Retinopathy of Prematurity: A Literature Review. Semin Ophthalmol. 2023;38(2):151-7.

4. Ahmed Kamal M, Ismail Z, Shehata IM, Djirar S, Talbot NC, Ahmadzadeh S, et al. Telemedicine, E-Health, and Multi-Agent Systems for Chronic Pain Management. Clin Pract. 2023;13(2):470-82.

5. Al-Arkee S, Mason J, Lane DA, Fabritz L, Chua W, Haque MS, et al. Mobile Apps to Improve Medication Adherence in Cardiovascular Disease: Systematic Review and Meta-analysis. J Med Internet Res. 2021;23(5):e24190.

6. Alghamdi NS, Alghamdi SM. The Role of

Digital Technology in Curbing COVID-19. Int J Environ Res Public Health. 2022;19.(14)

7. Ali F, Hamid U, Zaidat O, Bhatti D, Kalia JS. Role of Artificial Intelligence in TeleStroke: An Overview. Front Neurol. 2020;11:559322.

8. Andrès E, Meyer L, Zulfiqar AA, Hajjam M, Talha S, Bahougne T, et al. Telemonitoring in diabetes: evolution of concepts and technologies, with a focus on results of the more recent studies. J Med Life. 2019;12(3):203-14.

9. Andrès E, Talha S, Zulfiqar AA, Hajjam M, Ervé S, Hajjam J, et al. Current Research and New Perspectives of Telemedicine in Chronic Heart Failure: Narrative Review and Points of Interest for the Clinician. J Clin Med. 2018;7.(12)

10. Anto A, Sousa-Pinto B, Bousquet J. Anaphylaxis and digital medicine. Curr Opin Allergy Clin Immunol. 2021;21(5):448-54.

11. Armstrong GW, Lorch AC. A(eye): A Review of Current Applications of Artificial Intelligence and Machine Learning in Ophthalmology. Int Ophthalmol Clin. 2020;60(1):57-71.

12. Asan O, Choi E, Wang X. Artificial Intelligence-Based Consumer Health Informatics Application: Scoping Review. J Med Internet Res. 2023;25:e47260.

13. Ashraf M, Shokrollahi S, Salongcay RP, Aiello LP, Silva PS. Diabetic retinopathy and

ultrawide field imaging. Semin Ophthalmol. 2020;35(1):56-65.

14. Ashrafzadeh S, Hamdy O. Patient-Driven Diabetes Care of the Future in the Technology Era. Cell Metab. 2019;29(3):564-75.

15. Barrero-Castillero A, Corwin BK, VanderVeen DK, Wang JC. Workforce Shortage for Retinopathy of Prematurity Care and Emerging Role of Telehealth and Artificial Intelligence. Pediatr Clin North Am. 2020;67(4):725-33.

16. Bat-Erdene BO, Saver JL. Automatic Acute Stroke Symptom Detection and Emergency Medical Systems Alerting by Mobile Health Technologies: A Review. J Stroke Cerebrovasc Dis. 2021;30(7):105826.

17. Beaman CB, Kaneko N, Meyers PM, Tateshima S. A Review of Robotic Interventional Neuroradiology. AJNR Am J Neuroradiol. 2021;42(5):808-14.

18. Bellini V, Valente M, Gaddi AV, Pelosi P, Bignami E. Artificial intelligence and telemedicine in anesthesia: potential and problems. Minerva Anestesiol. 2022;88(9):729-34.

19. Bender W, Hiddleson CA, Buchman TG. Intensive Care Unit Telemedicine: Innovations and Limitations. Crit Care Clin. 2019;35(3):497-509.

20. Bendstrup E, Kronborg-White S, Møller J, Prior TS. Current best clinical practices for

monitoring of interstitial lung disease. Expert Rev Respir Med. 2022;16(11-12):1153-66.

21. Bertucci F, Le Corroller-Soriano AG, Monneur A, Fluzin S, Viens P, Maraninchi D, et al. [E-health and "Cancer outside the hospital walls", Big Data and artificial intelligence]. Bull Cancer. 2020;107(1):102-12.

22. Bhatt P, Liu J, Gong Y, Wang J, Guo Y. Emerging Artificial Intelligence-Empowered mHealth: Scoping Review. JMIR Mhealth Uhealth. 2022;10(6):e35053.

23. Blum A, Bosch S, Haenssle HA, Fink C, Hofmann-Wellenhof R, Zalaudek I, et al. [Artificial intelligence and smartphone program applications (Apps) : Relevance for dermatological practice]. Hautarzt. 2020;71(9):691-8.

24. Bonini N, Vitolo M, Imberti JF, Proietti M, Romiti GF, Boriani G, et al. Mobile health technology in atrial fibrillation. Expert Rev Med Devices. 2022;19(4):327-40.

25. Brady CJ, Garg S. Telemedicine for Age-Related Macular Degeneration. Telemed J E Health. 2020;26(4):565-8.

26. Brahmbhatt DH, Ross HJ, Moayedi Y. Digital Technology Application for Improved Responses to Health Care Challenges: Lessons Learned From COVID-19. Can J Cardiol. 2022;38(2):279-91.

27. Campbell CG, Ting DSW, Keane PA,

Foster PJ. The potential application of artificial intelligence for diagnosis and management of glaucoma in adults. Br Med Bull. 2020;134(1):21-33.

28. Chan S, Li L, Torous J, Gratzer D, Yellowlees PM. Review and Implementation of Self-Help and Automated Tools in Mental Health Care. Psychiatr Clin North Am. 2019;42(4):597-609.

29. Chandra M, Kumar K, Thakur P, Chattopadhyaya S, Alam F, Kumar S. Digital technologies, healthcare and Covid-19: insights from developing and emerging nations. Health Technol (Berl). 2022;12(2):547-68.

30. Chatterjee P, Tesis A, Cymberknop LJ, Armentano RL. Internet of Things and Artificial Intelligence in Healthcare During COVID-19 Pandemic-A South American Perspective. Front Public Health. 2020;8:600213.

31. Chehade MJ, Yadav L, Kopansky-Giles D, Merolli M, Palmer E, Jayatilaka A, et al. Innovations to improve access to musculoskeletal care. Best Pract Res Clin Rheumatol. 2020;34(5):101559.

32. Cheikh Youssef S, Haram K, Noël J, Patel V, Porter J, Dasgupta P, et al. Evolution of the digital operating room: the place of video technology in surgery. Langenbecks Arch Surg. 2023;408(1):95.

33. Chen Z, Liu Z, Du M, Wang Z. Artificial Intelligence in Obstetric Ultrasound: An Update and Future Applications. Front Med (Lausanne).

2021;8:733468.

34. Cheng SW, Chang CW, Chang WJ, Wang HW, Liang CS, Kishimoto T, et al. The now and future of ChatGPT and GPT in psychiatry. Psychiatry Clin Neurosci. 2023.

35. Chong NK, Chu Shan Elaine C, de Korne DF. Creating a Learning Televillage and Automated Digital Child Health Ecosystem. Pediatr Clin North Am. 2020;67(4):707-24.

36. Chou YB, Kale AU, Lanzetta P, Aslam T, Barratt J, Danese C, et al. Current status and practical considerations of artificial intelligence use in screening and diagnosing retinal diseases: Vision Academy retinal expert consensus. Curr Opin Ophthalmol. 2023;34(5):403-13.

37. Conard S. Best practices in digital health literacy. Int J Cardiol. 2019;292:277-9.

38. D'Amario D, Canonico F, Rodolico D, Borovac JA, Vergallo R, Montone RA, et al. Telemedicine, Artificial Intelligence and Humanisation of Clinical Pathways in Heart Failure Management: Back to the Future and Beyond. Card Fail Rev. 2020;6:e16.

39. Dabla PK, Gruson D, Gouget B, Bernardini S, Homsak E. Lessons Learned from the COVID-19 Pandemic: Emphasizing the Emerging Role and Perspectives from Artificial Intelligence, Mobile Health, and Digital Laboratory Medicine. Ejifcc. 2021;32(2):224-43.

40. Daley BJ, Ni'Man M, Neves MR, Bobby Huda MS, Marsh W, Fenton NE, et al. mHealth apps for gestational diabetes mellitus that provide clinical decision support or artificial intelligence: A scoping review. Diabet Med. 2022;39(1):e14735.

41. Das N, Topalovic M, Janssens W. Artificial intelligence in diagnosis of obstructive lung disease: current status and future potential. Curr Opin Pulm Med. 2018;24(2):117-23.

42. Denecke K, Gabarron E, Grainger R, Konstantinidis ST, Lau A, Rivera-Romero O, et al. Artificial Intelligence for Participatory Health: Applications, Impact, and Future Implications. Yearb Med Inform. 2019;28(1):165-73.

43. Deniz-Garcia A, Fabelo H, Rodriguez-Almeida AJ, Zamora-Zamorano G, Castro-Fernandez M, Alberiche Ruano MDP, et al. Quality, Usability, and Effectiveness of mHealth Apps and the Role of Artificial Intelligence: Current Scenario and Challenges. J Med Internet Res. 2023;25:e44030.

44. Di Carlo F, Sociali A, Picutti E, Pettorruso M, Vellante F, Verrastro V, et al. Telepsychiatry and other cutting-edge technologies in COVID-19 pandemic: Bridging the distance in mental health assistance. Int J Clin Pract. 2021;75.(1)

45. Duettmann W, Naik MG, Zukunft B, Osmonodja B, Bachmann F, Choi M, et al. eHealth in transplantation. Transpl Int. 2021;34(1):16-26.

46. Eadie LH, Seifalian AM, Davidson BR. Telemedicine in surgery. Br J Surg. 2003;90(6):647-58.

47. Edrees H, Song W, Syrowatka A, Simona A, Amato MG, Bates DW. Intelligent Telehealth in Pharmacovigilance: A Future Perspective. Drug Saf. 2022;45(5):449-58.

48. Egert M, Steward JE, Sundaram CP. Machine Learning and Artificial Intelligence in Surgical Fields. Indian J Surg Oncol. 2020;11(4):573-7.

49. Eggerth A, Hayn D, Schreier G. Medication management needs information and communications technology-based approaches, including telehealth and artificial intelligence. Br J Clin Pharmacol. 2020;86(10):2000-7.

50. Eggmann F, Weiger R, Zitzmann NU, Blatz MB. Implications of large language models such as ChatGPT for dental medicine. J Esthet Restor Dent. 2023.

51. El-Sherif DM, Abouzid M, Elzarif MT, Ahmed AA, Albakri A, Alshehri MM. Telehealth and Artificial Intelligence Insights into Healthcare during the COVID-19 Pandemic. Healthcare (Basel). 2022;10.(2)

52. Ellahham S. Artificial Intelligence: The Future for Diabetes Care. Am J Med. 2020;133(8):895-900.

53. Ellis TD, Earhart GM. Digital Therapeutics

in Parkinson's Disease: Practical Applications and Future Potential. J Parkinsons Dis. 2021;11(s1):S95-s101.

54. Elsner P, Bauer A, Diepgen TL, Drexler H, Fartasch M, John SM, et al. Position paper: Telemedicine in occupational dermatology - current status and perspectives. J Dtsch Dermatol Ges. 2018;16(8):969-74.

55. Erickson BJ, Shishani Y, Gobezie R. Remote Patient Monitoring of Postoperative Rehabilitation. Phys Med Rehabil Clin N Am. 2023;34(2):489-97.

56. Esposito S, Bianchini S, Argentiero A, Gobbi R, Vicini C, Principi N. New Approaches and Technologies to Improve Accuracy of Acute Otitis Media Diagnosis. Diagnostics (Basel). 2021;11.(12)

57. Evans CH, Schenarts KD. Evolving Educational Techniques in Surgical Training. Surg Clin North Am. 2016;96(1):71-88.

58. Evans CR, Medina MG, Dwyer AM. Telemedicine and telerobotics: from science fiction to reality. Updates Surg. 2018;70(3):357-62.

59. Ezzibdeh R, Munjal T, Ahmad I, Valdez TA. Artificial intelligence and tele-otoscopy: A window into the future of pediatric otology. Int J Pediatr Otorhinolaryngol. 2022;160:111229.

60. Fagherazzi G, Ravaud P. Digital diabetes:

Perspectives for diabetes prevention, management and research. Diabetes Metab. 2019;45(4):322-9.

61. Farahani N, Pantanowitz L. Overview of Telepathology. Surg Pathol Clin. 2015;8(2):223-31.

62. Fatehi F, Jahedi F, Tay-Kearney ML, Kanagasingam Y. Teleophthalmology for the elderly population: A review of the literature. Int J Med Inform. 2020;136:104089.

63. Fatehi F, Menon A, Bird D. Diabetes Care in the Digital Era: a Synoptic Overview. Curr Diab Rep. 2018;18(7):38.

64. Fawcett WJ, Klein AA. Anaesthesia and peri-operative medicine over the next 25 years. Anaesthesia. 2021;76(10):1416-20.

65. Ferro Desideri L, Rutigliani C, Corazza P, Nastasi A, Roda M, Nicolo M, et al. The upcoming role of Artificial Intelligence (AI) for retinal and glaucomatous diseases. J Optom. 2022;15 Suppl 1(Suppl 1):S50-s7.

66. Finley DS, Nguyen NT. Surgical robotics. Curr Surg. 2005;62(2):262-72.

67. Frei AL, Merki S, Henke MJ, Wey N, Moch H, Mertz KD, et al. [Future Medicine: Digital Pathology]. Ther Umsch. 2019;76(7):404-8.

68. Galetsi P, Katsaliaki K, Kumar S. The medical and societal impact of big data analytics and artificial intelligence applications in combating pandemics: A review focused on

Covid-19. Soc Sci Med. 2022;301:114973.

69. Ganapathy K, Abdul SS, Nursetyo AA. Artificial intelligence in neurosciences: A clinician's perspective. Neurol India. 2018;66(4):934-9.

70. George EI, Brand TC, LaPorta A, Marescaux J, Satava RM. Origins of Robotic Surgery: From Skepticism to Standard of Care. Jsls. 2018;22.(4)

71. Giansanti D. The Artificial Intelligence in Teledermatology: A Narrative Review on Opportunities, Perspectives, and Bottlenecks. Int J Environ Res Public Health. 2023;20.(10)

72. Gödeke J, Muensterer O, Rohleder S. [Artificial intelligence in pediatric surgery : Present and future]. Chirurg. 2020;91(3):222-8.

73. Goldust Y, Sameem F, Mearaj S, Gupta A, Patil A, Goldust M. COVID-19 and artificial intelligence: Experts and dermatologists perspective. J Cosmet Dermatol. 2023;22(1):11-5.

74. Gordon ES, Babu D, Laney DA. The future is now: Technology's impact on the practice of genetic counseling. Am J Med Genet C Semin Med Genet. 2018;178(1):15-23.

75. Gorincour G, Monneuse O, Ben Cheikh A, Avondo J, Chaillot PF, Journe C, et al. Management of abdominal emergencies in adults using telemedicine and artificial intelligence. J Visc Surg. 2021;158(3s):S26-s31.

76. Grauslund J. Diabetic retinopathy screening in the emerging era of artificial intelligence. Diabetologia. 2022;65(9):1415-23.

77. Graves JS, Montalban X. Biosensors to monitor MS activity. Mult Scler. 2020;26(5):605-8.

78. Greis C, Maul LV, Hsu C, Djamei V, Schmid-Grendelmeier P, Navarini AA. [Artificial intelligence to support telemedicine in Africa]. Hautarzt. 2020;71(9):686-90.

79. Gunasekeran DV, Ting DSW, Tan GSW, Wong TY. Artificial intelligence for diabetic retinopathy screening, prediction and management. Curr Opin Ophthalmol. 2020;31(5):357-65.

80. Gunasekeran DV, Tseng R, Tham YC, Wong TY. Applications of digital health for public health responses to COVID-19: a systematic scoping review of artificial intelligence, telehealth and related technologies. NPJ Digit Med. 2021;4(1):40.

81. Gupta PC, Kumar MP, Ram J. COVID-19 pandemic from an ophthalmology point of view. Indian J Med Res. 2020;151(5):411-8.

82. Gupta R, Kumari S, Senapati A, Ambasta RK, Kumar P. New era of artificial intelligence and machine learning-based detection, diagnosis, and therapeutics in Parkinson's disease. Ageing research reviews. 2023;90:102013.

83. Gutierrez L, Lim JS, Foo LL, Ng WY, Yip M,

Lim GYS, et al. Application of artificial intelligence in cataract management: current and future directions. Eye Vis (Lond). 2022;9(1):3.

84. Hallak JA, Scanzera AC, Azar DT, Chan RVP. Artificial intelligence in ophthalmology during COVID-19 and in the post COVID-19 era. Curr Opin Ophthalmol. 2020;31(5):447-53.

85. Halm-Pozniak A, Lohmann CH, Zagra L, Braun B, Gordon M, Grimm B. Best practice in digital orthopaedics. EFORT Open Rev. 2023;8(5):283-90.

86. Hamid N, Portnoy JM, Pandya A. Computer-Assisted Clinical Diagnosis and Treatment. Curr Allergy Asthma Rep. 2023;23(9):509-17.

87. Havelin A, Hampton P. Telemedicine and e-Health in the Management of Psoriasis: Improving Patient Outcomes - A Narrative Review. Psoriasis (Auckl). 2022;12:15-24.

88. Herkenrath SD, Dreher M, Gompelmann D, Held M, Koczulla AR, Köhnlein T, et al. Technical Innovations in Pneumology: E-Health, Screening, Diagnostics, and Therapy. Respiration. 2021;100(10):1009-15.

89. Hidalgo EM, Wright L, Isaksson M, Lambert G, Marwick TH. Current Applications of Robot-Assisted Ultrasound Examination. JACC Cardiovasc Imaging. 2023;16(2):239-47.

90. Hinchliffe N, Capehorn MS, Bewick M, Feenie J. The Potential Role of Digital Health in Obesity Care. Adv Ther. 2022;39(10):4397-412.

91. Hinck D, Friemert B. [Artificial intelligence, robotics and digitalization in the concept of military surgery of the German medical service]. Chirurg. 2020;91(3):240-4.

92. Hložánek M, Straňák Z, Terešková Z, Mareš J, Krejčířová I, Česká Burdová M. Trends in Neonatal Ophthalmic Screening Methods. Diagnostics (Basel). 2022;12.(5)

93. Honkoop P, Usmani O, Bonini M. The Current and Future Role of Technology in Respiratory Care. Pulm Ther. 2022;8(2):167-79.

94. Hsiao WW, Lin JC, Fan CT, Chen SS. Precision health in Taiwan: A data-driven diagnostic platform for the future of disease prevention. Comput Struct Biotechnol J. 2022;20:1593-602.

95. Huang JA, Hartanti IR, Colin MN, Pitaloka DA. Telemedicine and artificial intelligence to support self-isolation of COVID-19 patients: Recent updates and challenges. Digit Health. 2022;8:20552076221100634.

96. Huemer J, Wagner SK, Sim DA. The Evolution of Diabetic Retinopathy Screening Programmes: A Chronology of Retinal Photography from 35 mm Slides to Artificial Intelligence. Clin Ophthalmol. 2020;14:2021-35.

97. Ijaz SH, Shah SP, Majithia A. Implantable devices for heart failure monitoring. Prog Cardiovasc Dis. 2021;69:47-53.

98. Jedamzik S. [Digital health and nursing : The future is now]. Unfallchirurg. 2019;122(9):670-5.

99. Jheng YC, Kao CL, Yarmishyn AA, Chou YB, Hsu CC, Lin TC, et al. The era of artificial intelligence-based individualized telemedicine is coming. J Chin Med Assoc. 2020;83(11):981-3.

100. Jiang X, Xie M, Ma L, Dong L, Li D. International publication trends in the application of artificial intelligence in ophthalmology research: an updated bibliometric analysis. Ann Transl Med. 2023;11(5):219.

101. Jim HSL, Hoogland AI, Brownstein NC, Barata A, Dicker AP, Knoop H, et al. Innovations in research and clinical care using patient-generated health data. CA Cancer J Clin. 2020;70(3):182-99.

102. Jones M, DeRuyter F, Morris J. The Digital Health Revolution and People with Disabilities: Perspective from the United States. Int J Environ Res Public Health. 2020;17.(2)

103. Kagiyama N, Shrestha S, Farjo PD, Sengupta PP. Artificial Intelligence: Practical Primer for Clinical Research in Cardiovascular Disease. J Am Heart Assoc. 2019;8(17):e012788.

104. Kagiyama N, Tokodi M, Sengupta PP.

Machine Learning in Cardiovascular Imaging. Heart Fail Clin. 2022;18(2):245-58.

105. Kapoor R, Walters SP, Al-Aswad LA. The current state of artificial intelligence in ophthalmology. Surv Ophthalmol. 2019;64(2):233-40.

106. Kappel C, Rushton-Marovac M, Leong D, Dent S. Pursuing Connectivity in Cardio-Oncology Care-The Future of Telemedicine and Artificial Intelligence in Providing Equity and Access to Rural Communities. Front Cardiovasc Med. 2022;9:927769.

107. Kataria S, Ravindran V. Digital health: a new dimension in rheumatology patient care. Rheumatol Int. 2018;38(11):1949-57.

108. Kaushik A, Patel S, Dubey K. Digital cardiovascular care in COVID-19 pandemic: A potential alternative? J Card Surg. 2020;35(12):3545-50.

109. Keri VC, Hooda A, Kodan P, R LB, Jorwal P, Wig N. Intricate interplay between Covid-19 and cardiovascular diseases. Rev Med Virol. 2021;31(4):e2188.

110. Khalsa RK, Khashkhusha A, Zaidi S, Harky A, Bashir M. Artificial intelligence and cardiac surgery during COVID-19 era. J Card Surg. 2021;36(5):1729-33.

111. Khan MA, Alkaabi N. Rebirth of Distributed

AI-A Review of eHealth Research. Sensors (Basel). 2021;21.(15)

112. Khan ZF, Alotaibi SR. Applications of Artificial Intelligence and Big Data Analytics in m-Health: A Healthcare System Perspective. J Healthc Eng. 2020;2020:8894694.

113. Kiburg KV, Turner A, He M. Telemedicine and delivery of ophthalmic care in rural and remote communities: Drawing from Australian experience. Clin Exp Ophthalmol. 2022;50(7):793-800.

114. Kim YJ. The Future Medical Science and Colorectal Surgeons. Ann Coloproctol. 2017;33(6):207-9.

115. Kindle RD, Badawi O, Celi LA, Sturland S. Intensive Care Unit Telemedicine in the Era of Big Data, Artificial Intelligence, and Computer Clinical Decision Support Systems. Crit Care Clin. 2019;35(3):483-95.

116. Ko MW, Busis NA. Tele-Neuro-Ophthalmology: Vision for 20/20 and Beyond. J Neuroophthalmol. 2020;40(3):378-84.

117. Koppe G, Guloksuz S, Reininghaus U, Durstewitz D. Recurrent Neural Networks in Mobile Sampling and Intervention. Schizophr Bull. 2019;45(2):272-6.

118. Krittanawong C, Aydar M, Hassan Virk HU, Kumar A, Kaplin S, Guimaraes L, et

al. Artificial Intelligence-Powered Blockchains for Cardiovascular Medicine. Can J Cardiol. 2022;38(2):185-95.

119. Kulbayeva S, Tazhibayeva K, Seiduanova L, Smagulova I, Mussina A, Tanabayeva S, et al. The Recent Advances of Mobile Healthcare in Cardiology Practice. Acta Inform Med. 2022;30(3):236-50.

120. Kumar A, Gupta PK, Srivastava A. A review of modern technologies for tackling COVID-19 pandemic. Diabetes Metab Syndr. 2020;14(4):569-73.

121. Kurz A, Hauser K, Mehrtens HA, Krieghoff-Henning E, Hekler A, Kather JN, et al. Uncertainty Estimation in Medical Image Classification: Systematic Review. JMIR Med Inform. 2022;10(8):e36427.

122. Lai KE, Ko MW. Can Tele-Neuro-Ophthalmology Be Useful Beyond the Pandemic? Curr Neurol Neurosci Rep. 2023;23(2):15-23.

123. Land MR, Patel PA, Bui T, Jiao C, Ali A, Ibnamasud S, et al. Examining the Role of Telemedicine in Diabetic Retinopathy. J Clin Med. 2023;12.(10)

124. Li JO, Liu H, Ting DSJ, Jeon S, Chan RVP, Kim JE, et al. Digital technology, tele-medicine and artificial intelligence in ophthalmology: A global perspective. Prog Retin Eye Res. 2021;82:100900.

125. Li Y, Yip MYT, Ting DSW, Ang M. Artificial intelligence and digital solutions for myopia. Taiwan J Ophthalmol. 2023;13(2):142-50.

126. Lin CY, Sung HY, Chen YJ, Yeh HI, Hou CJ, Tsai CT, et al. Personalized Management for Heart Failure with Preserved Ejection Fraction. J Pers Med. 2023;13.(5)

127. Lin DJ, Finklestein SP, Cramer SC. New Directions in Treatments Targeting Stroke Recovery. Stroke. 2018;49(12):3107-14.

128. Lobato-Delgado B, Priego-Torres B, Sanchez-Morillo D. Combining Molecular, Imaging, and Clinical Data Analysis for Predicting Cancer Prognosis. Cancers (Basel). 2022;14.(13)

129. Loch T, Witzsch U, Reis G. [Digital transformation in urology-opportunity, risk or necessity?]. Urologe A. 2021;60(9):1125-40.

130. Ma MKI, Saha C, Poon SHL, Yiu RSW, Shih KC, Chan YK. Virtual reality and augmented reality- emerging screening and diagnostic techniques in ophthalmology: A systematic review. Surv Ophthalmol. 2022;67(5):1516-30.

131. Madabhushi A, Lee G. Image analysis and machine learning in digital pathology: Challenges and opportunities. Med Image Anal. 2016;33:170-5.

132. Malhotra K, Wong BNX, Lee S, Franco H, Singh C, Cabrera Silva LA, et al. Role

of Artificial Intelligence in Global Surgery: A Review of Opportunities and Challenges. Cureus. 2023;15(8):e43192.

133. Manteghinejad A, Javanmard SH. Challenges and opportunities of digital health in a post-COVID19 world. J Res Med Sci. 2021;26:11.

134. Mantokoudis G, Otero-Millan J, Gold DR. Current concepts in acute vestibular syndrome and video-oculography. Curr Opin Neurol. 2022;35(1):75-83.

135. Marsh A, Laxminarayan S, Bos L. Healthcare compunetics. Stud Health Technol Inform. 2004;103:3-11.

136. Martinez-Martin N, Luo Z, Kaushal A, Adeli E, Haque A, Kelly SS, et al. Ethical issues in using ambient intelligence in health-care settings. Lancet Digit Health. 2021;3(2):e115-e23.

137. Matthews PM, Block VJ, Leocani L. E-health and multiple sclerosis. Curr Opin Neurol. 2020;33(3):271-6.

138. Maurer LE, Bansal C, Bansal P. Methods to engage patients in the modern clinic. Ann Allergy Asthma Immunol. 2022;128(2):132-8.

139. McCauley JL, Swartz AE. Reframing Telehealth: Regulation, Licensing, and Reimbursement in Connected Care. Obstet Gynecol Clin North Am. 2020;47(2):227-39.

140. Miller E, Polson D. Apps, Avatars, and

Robots: The Future of Mental Healthcare. Issues Ment Health Nurs. 2019;40(3):208-14.

141. Miotto R, Wang F, Wang S, Jiang X, Dudley JT. Deep learning for healthcare: review, opportunities and challenges. Brief Bioinform. 2018;19(6):1236-46.

142. Mitek A. Anesthesiologists in the Ether: Technology and Telemedicine in Anesthesiology. Vet Clin North Am Small Anim Pract. 2022;52(5):1099-107.

143. Mitek A. Technology Basics for Telemedicine: What Practitioners Need to Know. Vet Clin North Am Small Anim Pract. 2022;52(5):1109-22.

144. Moraes JL, Rocha MX, Vasconcelos GG, Vasconcelos Filho JE, de Albuquerque VHC, Alexandria AR. Advances in Photopletysmography Signal Analysis for Biomedical Applications. Sensors (Basel). 2018;18.(6)

145. Mousavi T, Nikfar S, Abdollahi M. Achieving Equitable Access to Medicines and Health Services: A COVID-19-time Recalled Matter. Iran J Pharm Res. 2021;20(4):450-66.

146. Muntener M, Ursu D, Patriciu A, Petrisor D, Stoianovici D. Robotic prostate surgery. Expert Rev Med Devices. 2006;3(5):575-84.

147. Muro-Fuentes EA, Stunkel L. Diagnostic Error in Neuro-ophthalmology: Avenues

to Improve. Curr Neurol Neurosci Rep. 2022;22(4):243-56.

148. Naik N, Hameed BMZ, Sooriyaperakasam N, Vinayahalingam S, Patil V, Smriti K, et al. Transforming healthcare through a digital revolution: A review of digital healthcare technologies and solutions. Front Digit Health. 2022;4:919985.

149. Nakayama LF, Zago Ribeiro L, Novaes F, Miyawaki IA, Miyawaki AE, de Oliveira JAE, et al. Artificial intelligence for telemedicine diabetic retinopathy screening: a review. Ann Med. 2023;55(2):2258149.

150. Narasimha S, Madathil KC, Agnisarman S, Rogers H, Welch B, Ashok A, et al. Designing Telemedicine Systems for Geriatric Patients: A Review of the Usability Studies. Telemed J E Health. 2017;23(6):459-72.

151. Nath S, Marie A, Ellershaw S, Korot E, Keane PA. New meaning for NLP: the trials and tribulations of natural language processing with GPT-3 in ophthalmology. Br J Ophthalmol. 2022;106(7):889-92.

152. Nathoo N, Pesek T, Barnett GH. Robotics and neurosurgery. Surg Clin North Am. 2003;83(6):1339-50.

153. Nikolaidou A, Tsaousis KT. Teleophthalmology and Artificial Intelligence As Game Changers in Ophthalmic Care After the

COVID-19 Pandemic. Cureus. 2021;13(7):e16392.

154. Núñez Reiz A, Armengol de la Hoz MA, Sánchez García M. Big Data Analysis and Machine Learning in Intensive Care Units. Med Intensiva (Engl Ed). 2019;43(7):416-26.

155. Nußbeck G, Gök M. Technical literature review. Stud Health Technol Inform. 2013;187:23-39.

156. Oliva A, Grassi S, Vetrugno G, Rossi R, Della Morte G, Pinchi V, et al. Management of Medico-Legal Risks in Digital Health Era: A Scoping Review. Front Med (Lausanne). 2021;8:821756.

157. Osztrogonacz P, Chinnadurai P, Lumsden AB. Emerging Applications for Computer Vision and Artificial Intelligence in Management of the Cardiovascular Patient. Methodist Debakey Cardiovasc J. 2023;19(4):17-23.

158. Pallua JD, Brunner A, Zelger B, Schirmer M, Haybaeck J. The future of pathology is digital. Pathol Res Pract. 2020;216(9):153040.

159. Pap IA, Oniga S. A Review of Converging Technologies in eHealth Pertaining to Artificial Intelligence. Int J Environ Res Public Health. 2022;19.(18)

160. Parikh D, Armstrong G, Liou V, Husain D. Advances in Telemedicine in Ophthalmology. Semin Ophthalmol. 2020;35(4):210-5.

161. Park JH, Kim JH, Rogowski L, Al Shami

S, Howell SEI. Implementation of teledentistry for orthodontic practices. J World Fed Orthod. 2021;10(1):9-13.

162. Park Y, Lee C, Jung JY. Digital Healthcare for Airway Diseases from Personal Environmental Exposure. Yonsei Med J. 2022;63(Suppl):S1-s13.

163. Pasquali P, Sonthalia S, Moreno-Ramirez D, Sharma P, Agrawal M, Gupta S, et al. Teledermatology and its Current Perspective. Indian Dermatol Online J. 2020;11(1):12-20.

164. Perju-Dumbrava L, Barsan M, Leucuta DC, Popa LC, Pop C, Tohanean N, et al. Artificial intelligence applications and robotic systems in Parkinson's disease (Review). Exp Ther Med. 2022;23(2):153.

165. Perrone G, Bilotta C, Tullio V, Pirrone R, Argo A, Zerbo S. Telehealth modulation and new proposals during the Covid-19 pandemic: a literature review. Clin Ter. 2022;173(5):489-95.

166. Pieczynski J, Kuklo P, Grzybowski A. The Role of Telemedicine, In-Home Testing and Artificial Intelligence to Alleviate an Increasingly Burdened Healthcare System: Diabetic Retinopathy. Ophthalmol Ther. 2021;10(3):445-64.

167. Pradeepa R, Rajalakshmi R, Mohan V. Use of Telemedicine Technologies in Diabetes Prevention and Control in Resource-Constrained Settings: Lessons Learned from Emerging Economies.

Diabetes Technol Ther. 2019;21(S2):S29-s216.

168. Rabinovich EP, Capek S, Kumar JS, Park MS. Tele-robotics and artificial-intelligence in stroke care. J Clin Neurosci. 2020;79:129-32.

169. Ramasamy K, Mishra C, Kannan NB, Namperumalsamy P, Sen S. Telemedicine in diabetic retinopathy screening in India. Indian J Ophthalmol. 2021;69(11):2977-86.

170. Ramkumar PN, Haeberle HS, Bloomfield MR, Schaffer JL, Kamath AF, Patterson BM, et al. Artificial Intelligence and Arthroplasty at a Single Institution: Real-World Applications of Machine Learning to Big Data, Value-Based Care, Mobile Health, and Remote Patient Monitoring. J Arthroplasty. 2019;34(10):2204-9.

171. Ramsey A, Wu AC, Bender BG, Portnoy J. Teleallergy: Where Have We Been and Where Are We Going? J Allergy Clin Immunol Pract. 2023;11(1):126-31.

172. Reddy H, Joshi S, Joshi A, Wagh V. A Critical Review of Global Digital Divide and the Role of Technology in Healthcare. Cureus. 2022;14(9):e29739.

173. Reddy V, Brumpton L. Digital-driven service improvement during the COVID-19 pandemic. Paediatr Child Health (Oxford). 2021;31(5):220-2.

174. Reeves JJ, Pageler NM, Wick EC, Melton GB,

Tan YG, Clay BJ, et al. The Clinical Information Systems Response to the COVID-19 Pandemic. Yearb Med Inform. 2021;30(1):105-25.

175. Rubel P, Fayn J, Simon-Chautemps L, Atoui H, Ohlsson M, Telisson D, et al. New paradigms in telemedicine: ambient intelligence, wearable, pervasive and personalized. Stud Health Technol Inform. 2004;108:123-32.

176. Rumsfeld JS, Shah RU, Druz RS. Innovation in Cardiology: The ACC Innovation Program. Methodist Debakey Cardiovasc J. 2020;16(4):304-8.

177. Saadi R, Goldenberg D, Goldenberg D. Using Technology in Global Otolaryngology. Otolaryngol Clin North Am. 2018;51(3):555-61.

178. Sabri K, Ells AL, Lee EY, Dutta S, Vinekar A. Retinopathy of Prematurity: A Global Perspective and Recent Developments. Pediatrics. 2022;150.(3)

179. Scott BK, Miller GT, Fonda SJ, Yeaw RE, Gaudaen JC, Pavliscsak HH, et al. Advanced Digital Health Technologies for COVID-19 and Future Emergencies. Telemed J E Health. 2020;26(10):1226-33.

180. Seetharam K, Kagiyama N, Sengupta PP. Application of mobile health, telemedicine and artificial intelligence to echocardiography. Echo Res Pract. 2019;6(2):R41-r52.

181. Seger C, Cannesson M. Recent advances in the technology of anesthesia. F1000Res. 2020;9.

182. Sekhar LN, Juric-Sekhar G, Qazi Z, Patel A, McGrath LB, Jr., Pridgeon J, et al. The Future of Skull Base Surgery: A View Through Tinted Glasses. World neurosurgery. 2020;142:29-42.

183. Senbekov M, Saliev T, Bukeyeva Z, Almabayeva A, Zhanaliyeva M, Aitenova N, et al. The Recent Progress and Applications of Digital Technologies in Healthcare: A Review. Int J Telemed Appl. 2020;2020:8830200.

184. Shah S, Slaney E, VerHage E, Chen J, Dias R, Abdelmalik B, et al. Application of Artificial Intelligence in the Early Detection of Retinopathy of Prematurity: Review of the Literature. Neonatology. 2023:1-8.

185. Shah SK, McElfish PA. Cancer Screening Recommendations During the COVID-19 Pandemic: Scoping Review. JMIR Cancer. 2022;8(1):e34392.

186. Shah SS, Buddhavarapu A, Husain M, Sable C, Satou G. Impact of Technologic Innovation and COVID-19 Pandemic on Pediatric Cardiology Telehealth. Curr Treat Options Pediatr. 2022;8(4):309-24.

187. Shen J, Ghatti S, Levkov NR, Shen H, Sen T, Rheuban K, et al. A survey of COVID-19 detection and prediction approaches using mobile devices, AI, and telemedicine. Front Artif Intell.

2022;5:1034732.

188. Shen YT, Chen L, Yue WW, Xu HX. Digital Technology-Based Telemedicine for the COVID-19 Pandemic. Front Med (Lausanne). 2021;8:646506.

189. Sibley KG, Girges C, Hoque E, Foltynie T. Video-Based Analyses of Parkinson's Disease Severity: A Brief Review. J Parkinsons Dis. 2021;11(s1):S83-s93.

190. Silva-Cardoso J, Juanatey JRG, Comin-Colet J, Sousa JM, Cavalheiro A, Moreira E. The Future of Telemedicine in the Management of Heart Failure Patients. Card Fail Rev. 2021;7:e11.

191. Sim SS, Yip MY, Wang Z, Tan ACS, Tan GSW, Cheung CMG, et al. Digital Technology for AMD Management in the Post-COVID-19 New Normal. Asia-Pacific journal of ophthalmology (Philadelphia, Pa). 2021;10(1):39-48.

192. Soldozy S, Young S, Yağmurlu K, Norat P, Sokolowski J, Park MS, et al. Transsphenoidal surgery using robotics to approach the sella turcica: Integrative use of artificial intelligence, realistic motion tracking and telesurgery. Clin Neurol Neurosurg. 2020;197:106152.

193. Solomon DH, Rudin RS. Digital health technologies: opportunities and challenges in rheumatology. Nat Rev Rheumatol. 2020;16(9):525-35.

194. Song Y, Bernard L, Jorgensen C, Dusfour

G, Pers YM. The Challenges of Telemedicine in Rheumatology. Front Med (Lausanne). 2021;8:746219.

195. Sood SK, Rawat KS, Kumar D. Analytical mapping of information and communication technology in emerging infectious diseases using CiteSpace. Telemat Inform. 2022;69:101796.

196. Spethmann S, Köhler F. [Telemedicine in chronic heart failure-From clinical studies to standard care]. Internist (Berl). 2022;63(3):266-73.

197. Stanberry B. Telemedicine: barriers and opportunities in the 21st century. J Intern Med. 2000;247(6):615-28.

198. Stauss M, Floyd L, Becker S, Ponnusamy A, Woywodt A. Opportunities in the cloud or pie in the sky? Current status and future perspectives of telemedicine in nephrology. Clin Kidney J. 2021;14(2):492-506.

199. Stuermer L, Martin R. Characterization of technologies in digital health applied in vision care. J Optom. 2022;15 Suppl 1(Suppl 1):S70-s81.

200. Su J, Zhang Y, Ke QQ, Su JK, Yang QH. Mobilizing artificial intelligence to cardiac telerehabilitation. Rev Cardiovasc Med. 2022;23(2):45.

201. Tagde P, Tagde S, Bhattacharya T, Tagde P, Chopra H, Akter R, et al. Blockchain and artificial

intelligence technology in e-Health. Environ Sci Pollut Res Int. 2021;28(38):52810-31.

202. Tan NYQ, Friedman DS, Stalmans I, Ahmed IIK, Sng CCA. Glaucoma screening: where are we and where do we need to go? Curr Opin Ophthalmol. 2020;31(2):91-100.

203. Tarakji KG, Silva J, Chen LY, Turakhia MP, Perez M, Attia ZI, et al. Digital Health and the Care of the Patient With Arrhythmia: What Every Electrophysiologist Needs to Know. Circ Arrhythm Electrophysiol. 2020;13(11):e007953.

204. Taskin HE, Berber E. Robotic adrenalectomy. Cancer J. 2013;19(2):162-6.

205. Ting DSJ, Deshmukh R, Ting DSW, Ang M. Big data in corneal diseases and cataract: Current applications and future directions. Front Big Data. 2023;6:1017420.

206. Ting DSJ, Foo VH, Yang LWY, Sia JT, Ang M, Lin H, et al. Artificial intelligence for anterior segment diseases: Emerging applications in ophthalmology. Br J Ophthalmol. 2021;105(2):158-68.

207. Ting DSJ, Gopal BP, Deshmukh R, Seitzman GD, Said DG, Dua HS. Diagnostic armamentarium of infectious keratitis: A comprehensive review. Ocul Surf. 2022;23:27-39.

208. Ting DSW, Pasquale LR, Peng L, Campbell JP, Lee AY, Raman R, et al. Artificial intelligence and

deep learning in ophthalmology. Br J Ophthalmol. 2019;103(2):167-75.

209. Triantafyllidis AK, Tsanas A. Applications of Machine Learning in Real-Life Digital Health Interventions: Review of the Literature. J Med Internet Res. 2019;21(4):e12286.

210. Tsai AS, Chou HD, Ling XC, Al-Khaled T, Valikodath N, Cole E, et al. Assessment and management of retinopathy of prematurity in the era of anti-vascular endothelial growth factor (VEGF). Prog Retin Eye Res. 2022;88:101018.

211. Tsoi K, Yiu K, Lee H, Cheng HM, Wang TD, Tay JC, et al. Applications of artificial intelligence for hypertension management. J Clin Hypertens (Greenwich). 2021;23(3):568-74.

212. Tuon FF, Amato VS, Zequinao T, Cruz JAW. Emerging computational technologies in human leishmaniasis: where are we? Trans R Soc Trop Med Hyg. 2022;116(11):981-5.

213. Uppal SK, Beer J, Hadeler E, Gitlow H, Nouri K. The clinical utility of teledermoscopy in the era of telemedicine. Dermatol Ther. 2021;34(2):e14766.

214. Vagg T, Shanthikumar S, Morrissy D, Chapman WW, Plant BJ, Ranganathan S. Telehealth and virtual health monitoring in cystic fibrosis. Curr Opin Pulm Med. 2021;27(6):544-53.

215. Variane GFT, Camargo JPV, Rodrigues

DP, Magalhães M, Mimica MJ. Current Status and Future Directions of Neuromonitoring With Emerging Technologies in Neonatal Care. Front Pediatr. 2021;9:755144.

216. Vervoort D, Tam DY, Wijeysundera HC. Health Technology Assessment for Cardiovascular Digital Health Technologies and Artificial Intelligence: Why Is It Different? Can J Cardiol. 2022;38(2):259-66.

217. Vilela MAP, Arrigo A, Parodi MB, Mengue CDS. Smartphone Eye Examination: Artificial Intelligence and Telemedicine. Telemed J E Health. 2023.

218. Vincent JL, Creteur J. The hospital of tomorrow in 10 points. Crit Care. 2017;21(1):93.

219. Vujosevic S, Limoli C, Luzi L, Nucci P. Digital innovations for retinal care in diabetic retinopathy. Acta Diabetol. 2022;59(12):1521-30.

220. Wagner MW, Bilbily A, Beheshti M, Shammas A, Vali R. Artificial intelligence and radiomics in pediatric molecular imaging. Methods. 2021;188:37-43.

221. Wickramasinghe N. Essential Considerations for Successful Consumer Health Informatics Solutions. Yearb Med Inform. 2019;28(1):158-64.

222. Winterbottom FA. The Role of Tele-Critical Care in Rescue and Resuscitation. Crit Care Nurs

Clin North Am. 2021;33(3):357-68.

223. Wong TY, Sabanayagam C. Strategies to Tackle the Global Burden of Diabetic Retinopathy: From Epidemiology to Artificial Intelligence. Ophthalmologica. 2020;243(1):9-20.

224. Wu CT, Lin TY, Lin CJ, Hwang DK. The future application of artificial intelligence and telemedicine in the retina: A perspective. Taiwan J Ophthalmol. 2023;13(2):133-41.

225. Yang C, Zhao Z, Hu S. Image-based laparoscopic tool detection and tracking using convolutional neural networks: a review of the literature. Comput Assist Surg (Abingdon). 2020;25(1):15-28.

226. Yang YC, Islam SU, Noor A, Khan S, Afsar W, Nazir S. Influential Usage of Big Data and Artificial Intelligence in Healthcare. Comput Math Methods Med. 2021;2021:5812499.

227. Yi J, Zhang H, Mao J, Chen Y, Zhong H, Wang Y. Review on the COVID-19 pandemic prevention and control system based on AI. Eng Appl Artif Intell. 2022;114:105184.

228. Young AT, Xiong M, Pfau J, Keiser MJ, Wei ML. Artificial Intelligence in Dermatology: A Primer. J Invest Dermatol. 2020;140(8):1504-12.

229. Yuen J, Pike S, Khachikyan S, Nallasamy S. Telehealth in Ophthalmology. In: Linwood SL, editor. Digital Health. Brisbane (AU): Exon

Publications

230. Zhang C, Feng S, He R, Fang Y, Zhang S. Gastroenterology in the Metaverse: The dawn of a new era? Front Med (Lausanne). 2022;9:904566.

231. Zhang C, Zhao J, Zhu Z, Li Y, Li K, Wang Y, et al. Applications of Artificial Intelligence in Myopia: Current and Future Directions. Front Med (Lausanne). 2022;9:840498.

232. Zhang W, Li H, Cui L, Li H, Zhang X, Fang S, et al. Research progress and development trend of surgical robot and surgical instrument arm. Int J Med Robot. 2021;17(5):e2309.

233. Farrokhi M, Rigi A, Mangouri A, Fadaei M, Shabani E, Mashouf P, et al. Role of Antioxidants in Autoimmune Diseases. Kindle. 2021;1(1):1-107.

234. Farrokhi M, Shabani S, Rigi A, Seighalani HH, Pazhooha M, Bagheri S, et al. Academic Textbook: Anatomy, Pathophysiology, and Treatment of Pain. Kindle. 2023;3(1):1-123.

235. Farrokhi M, Vafaei S, Bidares M, Siami H, Rigi A, Hannaniyan M, et al. Diagnosis and

Treatment of Manifestations of COVID-19. Kindle. 2021;1(1):1-170.

236. Yarmohammadi B, Rigi A, Sahebkar F, Ahadiat S-A, Gharei F, Heydarian P, et al. Guidelines for Providing Services in Medical Departments During the COVID-19 Pandemic. Kindle. 2022;2(1):1-193.

237. Ahadiat S-A, Shirazinia M, Shirazinia S, Garousi S, Mottahedi M, Jalali AB, et al. Role of Telemedicine in Management of Patients During the COVID-19 Pandemic. Kindle. 2022;2(1):1-191.

238. Abadi SAH, Atbaei R, Forouhi M, Falaverjani HG, Moazamiyanfar R, Rezaei M, et al. Preventive and Therapeutic Approaches in Medical Departments During the COVID-19 Pandemic. Kindle. 2022;2(1):1-216.

239. Ahadiat S-A, Ghazalgoo A, Abadi SAH, Falaverjani HG, Bagherianlemraski M, Namazifar F, et al. Role of Vitamin D in Pathogenesis, Diagnosis, and Treatment of Inflammatory Diseases. Kindle. 2022;2(1):1-119.

240. Ahadiat S-A, Atighi J, Forouhi M, Mashatan N, Ghahremaniyeh Z, Radmanesh M, et al. Diagnosis and Management of Complications of COVID-19. Kindle. 2022;2(1):1-113.

241. Tabatabaei SOH, Moazamiyanfar R, Fard AM, Salemi MH, Masjedi MNK, Yazdani Y, et al. Academic Textbook: The Role of Melatonin in Pathogenesis and Treatment of Autoimmune

Diseases. Kindle. 2023;3(1):1-126.

242. Ahadiat S-A, Falaverjani HG, Shabani M, Abadi SAH, Moazamiyanfar R, Rajabi SK, et al. The Role of Stem Cells in Treatment of Autoimmune Diseases. Kindle. 2022;2(1):1-136.

243. Fard AM, Nikbakht T, Babaei N, Pouyamanesh M, Afzalian A, Kharazmkia A, et al. Role of Medicinal Plants in Treatment of Inflammatory Diseases. Kindle. 2022;2(1):1-139.

244. Ahadiat S-A, Barati R, Moghadam NS, Samami E, Ghiabi S, Alyari M, et al. Role of Oxidative Stress and Antioxidants in Malignancies. Kindle. 2022;2(1):1-122.

245. Ahadiat S-A, Kamrani K, Fard AM, Bagherianlemraski M, Rahimpour E, Jamali M, et al. Role of Blood Groups in Risk, Severity, Prognosis, and Response to Treatment of the Diseases. Kindle. 2022;2(1):1-130.

246. Ghalamkarpour N, Fard AM, Babazadeh A, Nikseresht H, Feyzmanesh A, Soltani R, et al. Role of Biomarkers in Risk, Diagnosis, Response to Treatment, and Prognosis of the Autoimmune Diseases. Kindle. 2022;2(1):1-124.

247. Talaie R, Fard SS, Forouhi M, Fard AM, Fard TM, Dadashzadehasl N, et al. Applications, Limitations, and Guidelines for the Use of Telemedicine in Medical Departments. Kindle. 2022;2(1):1-118.

248. Rahmani E, Fard AM, Baghsheikhi H, Hosseini Z, Mashaollahi A, Atighi J, et al. Role of Selenium in Pathogenesis and Treatment of the Autoimmune Diseases. Kindle. 2022;2(1):1-131.

249. Poudineh S, Poudineh M, Roohinezhad R, Khorram R, Fard AM, Barzegar F, et al. Role of Vitamins in Pathogenesis and Treatment of Cancers. Kindle. 2023;3(1):1-110.

250. Poudineh M, Poudineh S, Hosseini Z, Pouramini S, Fard SS, Fadavian H, et al. Risk Factors for the Development of Cancers. Kindle. 2023;3(1):1-118.

251. Amini N, Azimzadeh M, Dosar MD, Fard AM, Habibzadeh N, Yahyazadehjasour S, et al. Role of Microbiome, Infection, and Inflammation in Autoimmune Diseases. Kindle. 2023;3(1):1-102.

252. Taheri F, Farrokhi M, Fard AM, Rahmani E, Soltani R, Shamsedanesh S, et al. Role of Micronutrients and Nutrition in Prevention and Treatment of Cancers. Kindle. 2023;3(1):1-102.

253. Taheri F, Rahmani E, Fard SS, Rezaei M, Ayati A, Farhoudian A, et al. Aging Process and Related Diseases. Kindle. 2023;3(1):1-117.

254. Rahmani E, Rezaei M, Tavakoli R, Ghadirzadeh E, Sarnaghy FJ, Khorram R, et al. Role of Regenerative Medicine in the Treatment of Diseases. Kindle. 2023;3(1):1-184.

255. Rezaei M, Rahmani E, Khouzani SJ,

Rahmannia M, Ghadirzadeh E, Bashghareh P, et al. Role of Artificial Intelligence in the Diagnosis and Treatment of Diseases. Kindle. 2023;3(1):1-160.

256. Farrokhi M, Taheri F, Khouzani PJ, Rahmani E, Tavakoli R, Fard AM, et al. Role of Precision Medicine and Personalized Medicine in the Treatment of Diseases. Kindle. 2023;3(1):1-164.

257. Farrokhi M, Taheri F, Karami E, Khorram R, Sarnaghy FJ, Mirbolook A, et al. Effects of Environmental Factors and Epigenetic on Health and the Development of Diseases. Kindle. 2023;3(1):1-186.

258. Farrokhi M, Taheri F, Moeini A, Farrokhi M, Rabiei S, Farahmandsadr M, et al. Sex and Gender Differences in the Pathogenesis and Treatment of Diseases. Kindle. 2023;3(1):1-168.

259. Salehi N, Salehi A, Kalantari M. Unusual upper lip swelling: A review and a case report of cheilitis landularis. World Journal of Advanced Research and Reviews. 2023;19(1):181-7.

260. Salehi N, Salehi A. Contact lichenoid reaction in the oral cavity: A comprehensive focus on amalgam restoration. World Journal of Advanced Research and Reviews. 2023;18(2):134-44.

261. Tavakolinejad Z, Kamalabadi YM, Salehi A. Comparison of the Shear Bond Strength of Orthodontic Composites Containing Silver and Amorphous Tricalcium Phosphate Nanoparticles:

an ex vivo Study. Journal of Dentistry. 2023;24(3):285.

262. Navabi N, Salehi A, ZAREI MR, Borna R. Pain experience after oral mucosal biopsy: A quasi-experimental study. 2012.

263. Biglari N, Mehdizadeh A, Mastanabad MV, Gharaeikhezri MH, Afrakoti LGMP, Pourbala H, et al. Application of mesenchymal stem cells (MSCs) in neurodegenerative disorders: history, findings, and prospective challenges. Pathology-Research and Practice. 2023:154541.

263. Abbas Mofrad H, Khalatbari J, Malihi Zakerini S, Mohammadi Shirmahalleh F, Shafti V. Analysis of Structural Equations in the Relationship of Marital Conflicts and Affective Security with Perceived Stress and Pregnancy Worries and Biological Indexes with the Mediation of Psychological Wellbeing in Pregnant Women. Women Studies. 2021;12(35):97-127.

264. Abbasmofrad H, Khalatbari J, Zakerini SM, Mohammadi Shir Mahalla F, Shafti V. Analysis of Structural Equations in Relation to Marital Conflicts and Emotional Security with Perceived Stress and Pregnancy Worries Mediated by Psychological Well-Being in Pregnant Women. MEJDS. 2022;12:140.

265. ABBAS MOFRAD H, Mali Alzakerini S, ELAHI K. Efficacy of Mindfulness-Based Cognitive Therapy on the Cognitive Fusion and

Catastrophizing the Pain in the Women with Irritable Bowel Syndrome (IBS). Journal of Modern Psychological Researches. 2023;18.(70)

266. Abbas Mofrad H, Khalatbari J, Malihi Alzakerini S, Mohammadi Shir Mahalla F, Shafti V. Modeling Structural Equations in the Relationship Between Marital Conflicts and Emotional Security With Perceived Stress and Prenatal Concerns With Psychological Well-Being in Pregnant Women. Middle Eastern Journal of Disability Studies. 2022;12(0):140.-

267. Zahir ST, Hesami M, Gharaeikhezri A, Rahmani K, Zare S, Shafiee M. The Evaluation of the recurrence and survival in patients with papillary thyroid cancer: A retrospective Study. Pakistan Journal of Medical and Health Sciences. 2021;15(3):1074-7.

268. Bahardoust M, Hajializade M, Amiri R, Mousazadeh F, Pisoudeh K. Evaluation of health-related quality of life after total hip arthroplasty: a case-control study in the Iranian population. BMC musculoskeletal disorders. 2019;20(1):1-7.

269. Mirzashahi B, Hajializade M, Kordkandi SA, Farahini H, Moghtadaei M, Yeganeh A, et al. Spinopelvic Parameters as Risk Factors of Nonspecific Low Back Pain: A Case-Control Study. Medical Journal of the Islamic Republic of Iran. 2023;37.

Proof