ARTIFICIAL INTELLIGENCE IN HOSPITAL AND TREATMENT USING CHEMOTHERAPY: PRESENT AND FUTURE

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ABSTRACT

Medical technologies driven by artificial intelligence are swiftly advancing into practical applications for clinical practice. Deep learning algorithms can manage the growing volumes of data generated by wearables, smartphones, and various mobile monitoring devices across many medical fields. At now, the application of artificial intelligence is advantageous just in some clinical situations, including the identification of atrial fibrillation, epileptic seizures, and hypoglycemia, as well as the diagnosis of diseases through histological analysis or medical imaging. The introduction of augmented medicine is eagerly anticipated by patients as it facilitates more autonomy and personalised treatment; yet, it faces resistance from physicians who are unprepared for this progression in clinical practice. This issue necessitates the validation of contemporary instruments through traditional clinical trials, the reevaluation of medical curricula in the context of digital medicine, and the ethical considerations surrounding continuous monitoring. This study aims to examine recent scientific research and offer insights on the advantages, future prospects, and hazards associated with proven artificial intelligence applications in clinical practice, focussing on physicians, healthcare institutions, medical education, and bioethics.

KEYWORDS: Digital Medicine, Mobile Health, Medical Technologies, Artificial Intelligence, Monitoring

INTRODUCTION

The term “Medical Technology” encompasses various tools that assist health professionals in enhancing the quality of life for patients and society through early diagnosis, minimising complications, optimising treatment, offering less invasive alternatives, and decreasing hospitalisation duration. Prior to the mobile era, medical technologies were predominantly recognised as traditional medical devices (e.g., prosthetics, stents, implants). However, the advent of smartphones, wearables, sensors, and communication systems has transformed medicine by enabling the integration of artificial intelligence (AI)-powered tools (such as applications) in compact formats. Artificial Intelligence has transformed medical technology and is often defined as a branch of computer science capable of addressing intricate challenges across several domains characterised by extensive data yet limited theoretical frameworks [1].

Intelligent medical technologies, namely those driven by artificial intelligence, have garnered interest from the public due to its facilitation of a 4P model of medicine—Predictive, Preventive, Personalised, and Participatory—thereby enhancing patient autonomy in hitherto unattainable ways [2].

Smartphones are increasingly the primary tool for managing and disseminating electronic personal health records, monitoring vital signs with biosensors, and facilitating optimal medication adherence, therefore positioning the patient as the central participant in the care route [3-5]. The advancement of intelligent medical technology is facilitating the emergence of a novel domain in medicine: augmented medicine, which involves the application of innovative medical technologies to enhance many facets of clinical practice. Numerous AI-driven algorithms have received approval from the Food and Drug Administration (FDA) in the past decade and are therefore eligible for implementation. Augmented medicine is facilitated not just by AI-based technologies but also by many digital tools, including surgical navigation systems for computer-assisted surgery and virtual reality continuum tools for surgery, pain management, and mental diseases [6-9].

Despite the apparent success of augmented medicine with patients, it often faces opposition from healthcare professionals, particularly physicians. Four often cited causes for this phenomena should be addressed. The unpreparedness regarding the promise of digital medicine stems from a clear deficiency in foundational and ongoing education in this field. Secondly, the first digitisation of healthcare systems, apart from the anticipated benefits of enhanced medicine, resulted in a significant rise in administrative burdens mostly associated with electronic health records, which has emerged as a primary factor contributing to physician burnout. Third, there is growing apprehension over the potential of AI to supplant physicians, while prevailing scholarly consensus is that AI will augment physician intellect in the future. Fourth, the global absence of a legislative framework that delineates the idea of culpability for the acceptance or rejection of algorithmic advice renders the physician vulnerable to potential legal repercussions when using AI [10-16].

Due to the deficiency in education regarding digital medicine, numerous private medical schools are equipping their future medical leaders to confront the challenges of augmented medicine by integrating the medical curriculum with engineering studies or incorporating digital health literacy and application into an enhanced curriculum [17-19].

This paper aims to summarise recent advancements in AI within medicine, delineate primary use cases of AI-driven medical technologies currently applicable in clinical practice, and discuss the challenges and risks encountered by healthcare professionals and institutions in the implementation of augmented medicine, both in clinical settings and in the training of future medical leaders [20].

CONTEMPORARY UTILISATIONS OF ARTIFICIAL INTELLIGENCE IN MEDICINE

CARDIOLOGY

ATRIAL FIBRILLATION

The early identification of atrial fibrillation was among the initial applications of artificial intelligence in medicine. In 2014, AliveCor obtained FDA certification for their mobile application Kardia, which facilitates smartphone-based ECG monitoring and the identification of atrial fibrillation. The recent REHEARSE-AF research demonstrated that remote ECG monitoring using Kardia in ambulatory individuals is more effective in detecting atrial fibrillation compared to standard treatment. Apple has also secured FDA certification for the Apple Watch 4, which permits enables the convenient acquisition of ECG and identification of atrial fibrillation, which may be transmitted to the preferred practitioner via a smartphone . Numerous critiques of wearable and portable ECG technologies have been articulated, emphasising limitations such as the false positive rate due to movement artefacts and obstacles to the adoption of wearable technology among elderly patients who are more susceptible to atrial fibrillation [21-25].

CARDIOVASCULAR RISK ASSESSMENT

In the context of electronic patient records, artificial intelligence has demonstrated superior predictive capabilities for cardiovascular disease risks, such as acute coronary syndrome and heart failure, compared to conventional assessment scales. Recent extensive studies have indicated that outcomes may differ based on the sample size utilised in research reports [26].

RESPIRATORY MEDICINE

The analysis of lung function tests has been identified as a promising area for the advancement of AI applications in pulmonary medicine. A recent study shown that AI-based software offers enhanced accuracy in interpretation and functions as a decision support tool for analysing pulmonary function test data. The study faced many objections, one of which indicated that the rate of correct diagnoses among the pulmonologists included was significantly below the national norm [27].

ENDOCRINOLOGY

Continuous glucose monitoring allows diabetes patients to access real-time interstitial glucose measurements and offers insights into the direction and rate of blood glucose fluctuations. Medtronic obtained FDA approval for its smartphone-paired Guardian system for glucose monitoring. In 2018, the firm collaborated with Watson, an AI built by IBM, to enhance its Sugar.IQ solution, enabling clients to more effectively prevent hypoglycemia episodes through continuous monitoring. Continuous blood glucose monitoring allows patients to enhance their glucose regulation and mitigate the stigma linked to hypoglycemic incidents; nevertheless, a study examining patient experiences with glucose monitoring revealed that participants, despite expressing confidence in the notifications, also reported feelings of personal failure in managing their glucose levels [28].

NEPHROLOGY

Artificial intelligence has been utilised in several contexts within clinical nephrology. It has been demonstrated to be effective in predicting the deterioration of glomerular filtration rate in patients with polycystic kidney disease and in assessing the risk for progressive IgA nephropathy. Nonetheless, a recent assessment indicates that current research is constrained by the sample size required for inference [29].

GASTROENTEROLOGY

The field of gastroenterology is enhanced by a diverse array of AI applications in clinical environments. Gastroenterologists using convolutional neural networks, along with other deep learning models, to analyse pictures obtained via endoscopy. Ultrasound identifies abnormal formations, including colonic polyps. Artificial neural networks have been employed to diagnose gastro-oesophageal reflux disease and atrophic gastritis, as well as to forecast outcomes in gastrointestinal bleeding, esophageal cancer survival, inflammatory bowel disease, and metastasis in colorectal cancer and esophageal squamous cell carcinoma [30-39].

NEUROLOGY

EPILEPSY

Intelligent seizure detection devices are promising technologies capable of enhancing seizure management via continuous ambulatory monitoring. In 2018, Empatica obtained FDA approval for their wearable device, Embrace, which utilises electrodermal sensors to detect generalised epilepsy seizures and communicate with a mobile application that alerts relatives and trusted physicians with pertinent information regarding the patient's location. A survey on patient experience indicated that, unlike heart monitoring wearables, individuals with epilepsy encountered no obstacles in adopting seizure detection devices and expressed significant enthusiasm in using wearables [40].

EVALUATION OF GAIT, POSTURE, AND TREMOR

Wearable sensors have demonstrated efficacy in quantitatively evaluating gait, posture, and tremor in individuals with multiple sclerosis, Parkinson's disease, Parkinsonism, and Huntington's disease [41].

COMPUTATIONAL CANCER DIAGNOSIS IN HISTOPATHOLOGY

Paige.ai has obtained breakthrough designation from the FDA for an AI-driven system that accurately diagnoses cancer in computational histopathology, enabling pathologists to allocate more time on critical slides [42].

MEDICAL IMAGING AND VALIDATION OF AI-DRIVEN TECHNOLOGIES

A comprehensive meta-analysis evaluated the performance of deep learning software against radiologists in imaging-based diagnosis. While deep learning appears to be as effective as radiologists for diagnostic purposes, the authors noted that 99% of the studies lacked a robust design. Moreover, only one in a thousand reviewed papers validated their findings by employing algorithms to diagnose medical imaging from alternative source populations. These findings underscore the necessity for comprehensive validation of AI-based systems via rigorous clinical trials [43-47].

DISCOURSE: OBSTACLES AND FUTURE PATHS OF ARTIFICIAL INTELLIGENCE IN MEDICINE

VALIDATION OF AI-DRIVEN TECHNOLOGIES: IS A REPLICATION CRISIS IMMINENT?

A primary difficulty in the implementation of AI in medicine in the next years will be the clinical confirmation of fundamental notions and freshly designed instruments. Despite several studies demonstrating the utility of AI with evident prospects stemming from promising outcomes, certain acknowledged and often documented constraints of AI research are likely to hinder such validation. The bulk of research comparing the efficiency of AI and physicians exhibit unreliable design and lack primary replication, namely the validation of algorithms in samples from sources distinct from those used for training the algorithms. This challenge may be surmounted in the era of open science, since open data and open methodologies are increasingly seen as exemplary practices in research. Nonetheless, the shift to open science may provide challenges for medical AI startups that primarily focus on software development [45].

Secondly, research on the application of AI in clinical practice is constrained by retrospective designs and sample sizes, which may introduce selection and spectrum bias. This occurs when models are tailored to fit a specific dataset optimally, a phenomenon referred to as overfitting, yet fail to yield consistent results in other datasets. Ongoing reassessment and adjustment following the implementation of algorithms suspected of overfitting are essential to accommodate variations in patient demographics. Moreover, there is an increasing agreement on the necessity of developing algorithms tailored for bigger populations, while considering subgroups [46].

Third, few studies have been conducted to compare AI and clinicians using identical data sets; even in such cases, critics have highlighted a lower diagnosis accuracy rate than anticipated among specialist physicians. Contrasting AI with clinicians, while prevalent in scientific literature, may not be the most effective approach to addressing performance in medical expertise; numerous studies are now examining the synergy between clinicians and algorithms, as the integration of human and artificial intelligence surpasses the efficacy of either independently [57].

ETHICAL CONSIDERATIONS OF CONTINUOUS SURVEILLANCE

Medical technology is one of the most promising sectors of the 21st century, with an anticipated market value of one trillion dollars in 2019. A growing proportion of revenue is attributable to the sale of medical equipment, such as heart monitors, to a younger demographic, which is not the primary target customer profile due to the lower likelihood of health issues like atrial fibrillation. This phenomenon is reinventing the notion of a healthy individual through the Internet of Things (IoT), which integrates the quantified self (personal metrics recorded via smartphones or wearables) with other lifestyle factors supplied by wearables (such as activity tracking and weight management) [48].

Moreover, in recent years, several wearable technology businesses have finalised significant agreements with insurance providers or governmental entities to facilitate the extensive distribution of these items; such activities include primarily intended to promote lifestyle modification across extensive populations. Western nations are progressing towards health systems that emphasise individual responsibility for personal health and well-being, while the ethical ramifications of continuous medical monitoring via Internet of Things devices are often debated. Continuous surveillance and breaches of privacy may exacerbate stigma associated with chronically sick or marginalised individuals [49].

There is a possibility of penalising persons who cannot accept new healthy living norms, such as by restricting access to health insurance and care; yet, minimal debate has addressed these significant issues in health policy formulation. Within this techno-political context, the matter of data security and ownership is increasingly critical, although being almost two decades old. The literature delineates various perspectives on data ownership: while some studies advocate for communal ownership of patient data to enhance personalised medicine, there is a growing consensus favouring patient ownership, which positively influences patient engagement and may facilitate information sharing if a data use agreement is established between patients and healthcare professionals [50-61].

THE NECESSITY OF EDUCATING AUGMENTED PHYSICIANS

Numerous institutions have commenced the development of innovative medical curricula, including a doctor-engineering program, to address the necessity of training future medical leaders regarding the problems posed by artificial intelligence in medicine. These curriculum emphasise a more rigorous focus on the hard sciences, including physics and mathematics, while including computer sciences, coding, algorithmics, and mechatronic engineering. These "augmented doctors" would leverage both clinical knowledge and digital proficiency to address contemporary health issues, contribute to the formulation of digital strategies for healthcare organisations, oversee the digital transformation, and educate patients and colleagues. Society and healthcare institutions might gain from these individuals as a safeguard for AI integration in medicine, as well as a catalyst for innovation and research. In addition to fundamental medical education, there is a necessity for the establishment of continuous educational programs focused on digital medicine, aimed at retraining graduating physicians in this expanding domain. In several advanced institutions globally, such specialists hold the position of Chief Medical Information Officer (CMIO).

THE POTENTIAL OF AMBIENT CLINICAL INTELLIGENCE: PREVENTING DEHUMANISATION VIA TECHNOLOGY

Numerous studies indicate that electronic health records might impose significant administrative burdens and contribute to burnout, a problem increasingly observed among both trainee and practicing physicians. While artificial intelligence technologies, including Natural Language Processing, are increasingly becoming while more proficient in assisting physicians with comprehensive medical data, further solutions are required to address the growing time dedicated to indirect patient care [62-71].

Ambient clinical intelligence (ACI) refers to a sensitive, adaptable, and responsive digital environment that envelops both the physician and the patient, capable of analysing the interview and automatically populating the patient's electronic health records. Numerous initiatives are in progress to create an ACI, which would serve as a vital application of artificial intelligence in medicine, essential for addressing contemporary challenges related to the medical workforce.

A significant obstacle to the integration of advanced medical technology among physicians is the apprehension over the dehumanisation of medicine. This is mostly attributable to the escalating administrative load put on physicians. Nevertheless, contemporary technologies like ACI and Natural Language Processing are poised to alleviate administrative burdens, enabling physicians to concentrate more on patient care [72-79].

WILL PHYSICIANS BE SUPPLANTED BY ARTIFICIAL INTELLIGENCE?

Recent literature indicates that physicians are unlikely to be supplanted by artificial intelligence; rather, advanced medical technology serve as adjuncts to enhance patient treatment. Recent research have suggested, however, that comparisons often arise between artificial intelligence solutions and physicians, as if the two entities were in conflict [80-87]. Future research should concentrate on comparing physicians utilising artificial intelligence solutions with those not employing such applications, and extend these comparisons to translational clinical trials; only then will artificial intelligence be recognised as a complement to physicians. Healthcare professionals now occupy a fortunate position to embrace digital innovation and serve as primary agents of change; nevertheless, a significant overhaul of medical education is necessary to equip future leaders with the requisite competencies [88-90].

CONCLUSION

The integration of artificial intelligence in clinical practice is a promising area of advancement, evolving swiftly with other contemporary domains such as precision medicine, genomics, and teleconsultation. Scientific advancement must maintain rigour and transparency in creating innovative solutions for contemporary healthcare, while health policy should prioritise addressing the ethical and financial challenges inherent in this fundamental aspect of medical evolution.

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