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MEDICAL EDUCATION

ARTIFICIAL INTELLIGENCE: A NEW PATHWAY IN SCREENING, DIAGNOSIS AND TREATMENT OF COLORECTAL CANCER

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ABSTRACT

The increasing incidence of global colorectal cancer (CRC) cases is overwhelming the CRC healthcare industry. Artificial intelligence (AI) comes to light at this juncture and offers hope for early detection, diagnosis and treatment. In turn, the CRC-associated mortality rate will be reduced in more efficient and cost-effective ways. Nonetheless, despite the potential benefits of AI technology in the CRC healthcare industry, its applications are still in the early stages, and much work is required before its advantages are fully leveraged.

INTRODUCTION

Cancer is one of the major causes of death worldwide, with approximately 10 million deaths in 2020, with colorectal cancer (CRC) ranked the third most common cancer (10.7%) worldwide, after breast (12.5%) and lung (12.2%) cancers.[1,2] The rising trend of global CRC cases is anticipated to exert pressure on the healthcare and financial systems; furthermore, it can elevate the risks of mortality related to CRC. This has motivated the exploration of new technologies to efficiently manage the escalating demand for various types of labour-intensive and time-consuming examinations. Consequently, Artificial intelligence (AI) has become one of the most popular innovative tools to provide optimal intervention in the CRC healthcare domain, including performing screenings, diagnostics and treatments for CRC patients. The successful evolution of AI applications could become a cornerstone to this industry because AI tools have the potential to address the enormous demand for CRC examinations and treatments in a more efficient, cost-effective and practical way.

AI Applications: Opportunities

Improve Early Diagnosis and Reduce Mortality Rate of CRC

The application of AI is anticipated to enhance the CRC screening rate and, thus, improve the early detection and diagnosis of CRC, thereby alleviating the mortality rate. The many benefits expect to be realised by AI are the ability to manipulate and extract relevant information from mass data, function as an "extra pair of eyes"[6] and assist in real-time clinical decision-making. AI's high-level auxiliary diagnostic system enhances comprehension ability and

Table 1: AI applications improve colorectal cancer screening

Types of CRC screening	Limitations	Advantages of AI
Colonoscopy	• Some interval CRC cases detected in patients despite negative colonoscopy results[3] • False negative for polyp' detection: any size ~22%; size <5mm ~25%;[4]	• To minimise the risks of missed diagnosis, improve visualisation and evaluation of precancerous polyps
Virtual Colonoscopy (or CT colonography)	• Risks of missing some flattened and small polyp's size < 8 mm[5]	• To achieve optimal solutions • Improve automatic colorectal polyp detection and classification[6]
Capsule endoscopy	• Each video capture has a lengthy review time (45-50 mins;[6] • Limited to lesion visualisation • No capability for polypectomy or biopsy (performed at colonoscopy;[7]	• To reduce the risks of human error and improve accuracy of reading and examination results[8,9]
Blood tests	• Poor sensitivity and/or lack of evidence for early-stage detection[7]	• To detect CRC at early stages by enhancing sensitivity and specificity rate[6]

interpretability of medical images, improves the accuracy of evaluation and diagnosis and, thus, increases precise clinical and therapeutic decisions.[10] A systematic review by Mehta and colleagues[11] argued that, compared with conventional colonoscopy, AI-assisted colonoscopy is considered a breakthrough because its secure and potent screening increases the detection rate of adenomas and precancerous polyps and, hence, supports the accurate and early diagnosis of CRC. On the other hand, robotic-assisted CRC surgery could facilitate technically challenging procedures, in particular to assist with accessing areas that are difficult to reach, such as the distant caecum,[6] which in turn can improve the success rate of surgery.

Cost Effectiveness and Time Efficiency

Escalation of demand for CRC diagnosis and treatments could exert a financial burden and overwhelm the public healthcare system. The success of AI applications in CRC diagnosis and treatment domains can provide cost effective and time efficient treatments without compromising diagnostic validity.[12] Capitalising on the advantages of AI technology, by intensifying the frequency of CRC screening to the optimal level, such as from a biennial to annual screening, could reduce the CRC-associated death rate.[13] In the United States, application of AI-assisted colonoscopy screening is estimated to have reduced the Government's annual expenditure by USD290 million. More importantly, the application of AI successfully intercepted 7,194 colorectal cancer cases and 2,089 associated deaths.[14] Therefore, maximising the potential of AI technology can be an alternative solution to the current challenges in colorectal cancer liver metastasis management, including timely diagnosis, solid prognostic factor identification, and ideal treatment options,[15] thus minimising CRC-associated mortality.

Raising Self-awareness of CRC

CRC affects the world population differently but remains a highly preventable disease. Raising self-awareness of CRC risk factors could lower the risk of CRC-related mortality. Mobile phones are no longer a luxury item and usage is now part of most individual's daily necessity, so integrating AI technology into mobile applications to promote self-awareness of CRC could be an ideal approach. For instance, an AI-based assisted health mobile app-Colorectal Cancer Awareness Application (ColorApp)-was developed to educate the Malaysian community about colorectal cancer[16] and to encourage participation in CRC screening programs. Optimal routine examinations will help in early detection and diagnosis of this malignancy and, thus, could reduce the risk of CRC-related mortality rate.

AI Applications: Challenges

Big Data and High-Quality Data

Large data inflow, algorithm models, and computing power are the core support and the foundation for the operation of AI.[10] Therefore, this requires a wide level of clinical collaborations between countries, nations, localities and medical centres to standardise the huge inflow of medical data while ensuring that the quality and validity of the data is upheld. The

sharing of big and high-quality data could enable better conclusions to be drawn and, thus, increase precision in decision-making. At this juncture, proper data management is pertinent as it enhances model generalizability and comprehensive comparison of outcomes for treatment. In contrast, poor data management will lead to the risks of misinterpretation of clinical outcomes and decisions.

AI-medical Ethics Guidelines

Patient safety should be prioritised in any medical-related procedures. Therefore, the establishment of AI-medical ethics guidelines[17] that provide appropriate direction and guidance about the established norms of employing AI technology in life-altering decisions is warranted to reaffirm the trustworthiness of its application in the healthcare industry. Security of patient data and privacy protection are among the challenges that need to be addressed before the full implementation of AI in the healthcare industry. Considerations should deliberate on scrutinising and tightening existing laws to avoid any loopholes to personal health data breaches and/or risks of being hacked for malevolent intentions.[18] More importantly, organisations and institutions need to be legally bound to uphold the law and regulations to affirm that patients' rights and personal information are securely protected.

CONCLUSION

The emergence of AI technology offers a promising prospect in the CRC healthcare industry. By leveraging the continuous revolution of AI technology in the healthcare industry, specifically in the CRC domain, AI is anticipated to bring about significant improvements in the lives of CRC patients while enhancing medical practices and facilitating better decision-making. Although AI technology shows great promise in the CRC healthcare industry, complete replacement of clinical professionals by AI is an unlikely reality. A steady and measured approach is important to ensure that the integration of AI technology into medical practices is safe and effective.

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