Can Neural Networks Help Diagnose?

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Abstract - *The coupling of artificial intelligence technologies with advanced medical practice may improve the practice of medicine and deliver efficient results for patients and providers alike. Advancements in data collection, electronic records and neural networks synergistically advance the goal. Case studies on various types of cancer and other serious life-threatening diseases are available for artificially intelligent technologies to utilize in the furtherance of disease detection and treatment. Artificial intelligence is advancing on several fronts and the synergy of these advances is exciting for the medical community.*

Keywords: artificial intelligence; electronic records; colorectal cancer; diagnostics; treatment

Type: Short Research Paper

I. INTRODUCTION

The goal of the work presented in this paper is to offer possible methods to advance the study of artificial intelligence in medicine. The use of artificial intelligence in e-commerce was designed to facilitate transactions for buyers as well as sellers. It has been proposed that artificial intelligence may also facilitate disease fighting. Can neural networks assist physicians to diagnose? The synergistic possibilities offer advances in medicine around the world.

II. LITERATURE REVIEW

A. Early Concepts of Artificial Intelligence

Although the term artificial intelligence is little more than sixty years old, ancient Greek myths describe a giant man of bronze who guarded Europa from attackers by patrolling the island three times a day [1]. Peoples of Egypt joined Greeks in ancient times to worship cult images in human form. Further, Intelligent non-human beings were popular in Western fictional writings in the United States' nineteenth and twentieth centuries.

Innovations in ancient times by philosophers and mathematicians originated logical or mechanical reasoning. Greeks Pythagoras and Heraclitus developed concepts that ultimately formed the basis of programming computers. Meticulous logic led to mathematical solutions to complex problems. Hundreds of years later, during World War II, Alan Turing used logical, cryptology, and electrical talents to propose and prove that a mechanical and digital machine could make mathematical decisions using a binary numbering system consisting only of zero and one [1].

Expansion of artificial intelligence reached beyond myths, modern fiction, mathematical theories, and computer design. Guided by companies leading technological and social media applications, retail stores broadcast greetings from humanoids; manufacturers of smart phones build in voices clever enough to guide drivers across city and state routes; and robotic assistants record schedules and remind children and adults alike of appointments [4].

B. Advancements in Data Collection for Medicine

Electronic medical records (EMR) give doctors and scientists laboratory results, eliminating paper reports. EMRs require fewer resources and reduce waste. Analysis considered needs assessment for every report to determine elimination. After two years, 99% fewer monthly reports were printed – from 84,000 to 370. The initiative to combine data analysis and practitioners' needs was effective in lowering cost and time while maintaining accurate patient information [3].

C. Cancer Diagnostics

A deficiency in analyzing cancer with somatic mutation and sequencing techniques was identified. Even though long-standing, conventional order and report processes are effective for testing single genes, obstacles are numerous, and stimulating computers to develop artificial intelligence is crucial to complex genetic tests [9].

Complex tests require storing, tracking, and summarizing variants of sequences and correlating metabolic pathways. Thereafter, physicians need visual representations of profiles to pursue indicators for custom-designed patient treatments [9]. Conclusions dependent on integrating large volumes of clinical, molecular, social, and environmental data are not possible without efforts to increase artificial intelligence.

D. Diagnosis of Colorectal Cancer

Doctors cannot construct accurate expectations for groups of patients with symptoms of colorectal disease, and it is often unknown who has polyps, cancer, or colitis [5]. The common question for patients with colorectal symptoms

is does colorectal pathology give significant indicators to order a Lower Gastrointestinal Endoscopy (LGE)?

Clinical experience, judgment, and statistics from linear models are the foundation for predictable expectations. Assessments by clinicians are inaccurate and have an unacceptable rate of 20-40% of colonoscopies that are not necessary or not helpful in a large sample of cases. The protocol, to wait no longer than two weeks before ordering a LGE, was changed to improve the percentage. Selecting the time period was subjective and the revised protocol did not meet new goals of diagnosis. Specifically, reducing the time to order procedures produced only 14% accurate diagnosis of colorectal cancer. The lack of abnormal findings in most patients indicated that models for expert systems were deficient in sophisticated dependable artificial intelligence as diagnostic systems [5].

E. Artificial Intelligence and Pathology

Pathologists are occupied with interpreting slides and describing their interpretations in reports to colleagues, administrators, and government officials. Working to examine slides with blood and tissue samples is incomplete without documenting findings, possible findings, and lack of findings. Scientists continually try to find methods to lessen the administrative time to produce reports.

Efforts to develop artificial intelligence methods to complete clerical activities used a system designated as Secretary-Mimicking Artificial Intelligence (SMILE). As pathologists describe slides orally, systems developed by Sunquest Information Systems and Microsoft generate voice commands caused by pathologists and slide barcode scans. The composite of computer programs that make up SMILE responds to the commands and produces reports. SMILE also broadcasts comments to pathologists and exhibits comments on computer monitors; comments are helpful for pathologists making changes before reports are final [10].

Results of the artificial intelligence body of systems are favorable and constructive; SMILE allows pathologists to concentrate on analyzing slides with less effort to document reports. The system is fast and consistent, increasing pathologists' productivity, reducing errors, and deflecting stressful reporting tasks. Furthermore, SMILE learns continually from repetitive encounters; continuous improvement is an element of its design and function [10].

F. Case Study of Data Mining of Irritable Bowel Syndrome

A plan was developed to determine how quality of health and life deteriorates in the presence of irritable bowel syndrome (IBS). Conceiving of the study, they emphasized the dearth of predictive variables that can influence quality of life for patients with the ailment. Studying quality of life related to IBS meant expanding artificial intelligence with data mining techniques for a select group of patients. In fact, the researchers intended to examine and compare methods of data mining to determine the degree of correlation between demographic groups and IBS symptoms. Degrees of correlations could support or dispel associations of IBS and quality of life in certain groups [7].

A design was concieved consisting of a cross-sectional survey of the general population of the United Kingdom (UK). The methodology was to select people exhibiting IBS symptoms and subject them to a longitudinal cohort survey using a UK-wide newspaper alert for recruitment. They measured quality of life related to health with a succession of survey questions. Artificial intelligence in the form of data mining models resolved which factors associated with reduced health-related quality of life were relevant in the study; models comprised logistic regression, a classification tree, and artificial neural networks [7].

Results indicated that emotional melancholy and social status, such as married and employed, were significant factors in health-related quality of life for IBS patients. It was concluded that data mining was not so easy to interpret as logistic regression; however, data mining methods identified subsets of factors significantly related to IBS signs and emotional states of subjects. There was a strong statistical correlation between health-related quality of life in the UK. The hypothesis that quality of life was damaged for UK citizens with IBS was accepted. Further studies, to identify the effect of emotional and social status on health-related quality of life, might reveal more correlations with IBS. Such studies could magnify understanding emotional, social, and physical factors. Relevant studies could contribute to improving clinical practices to diagnose and treat the patient population [7].

G. Case Study of Nonsurgical Treatment

A study concluded that it is common for physicians to manage patients diagnosed with colorectal cancer without resecting the original tumor. Following discussion of specific cases, a multidisciplinary team (MDT) made the decision. Effectiveness of case management without resectional surgery to remove the primary tumor is questionable, especially because most patients have distant metastatic disease [8].

However, data for such a patient population indicate that 20–30% of patients with recent confirmation of colorectal cancer have synchronous distant metastatic disease. Subsequent to diagnosis, most patients are classified as incurable using surgical methods. The statistics were contraindicative notwithstanding evidence that the primary tumor appeared to be easily resectable. Arguments continue for and against resecting the primary tumor in patients thought to be incurable, although statistical evidence indicates benefits only for a small group. Nonetheless, the primary goal for treating patients with unresectable metastatic disease is palliation, focusing on controlling symptoms and maintaining quality of life [8].

H. Case History of Surgical Treatment

Not all elements of colorectal resection are advantageous, nor do they deliver superior results in treating patients [2]. For example, duration of an operation was

greater with procedures that involved robot assistance: 270 minutes compared to 138 minutes for right hemicolectomy; 200 versus 140 for sigmoid colectomy; and 180 over 165 for rectopexy. The information originated in a matched cohort study using a robot. The robot's function was only to reposition the colon. Further, a bowel grasper assisted the robot through a port created to provide access.

Robot-assisted surgeries evaluated in the study consisted of two right hemicolectomies, three sigmoid colectomies, and one rectopexy. Partial reports of outcomes contained information about a patient in the robotic population who contracted atelectasis following a right hemicolectomy. Another patient suffered a late incisional hernia after a sigmoid colectomy; the patient was in a group receiving laparoscopic treatment.

Another case involved a sigmoid colectomy changed after 50 minutes to laparoscopy due to a problem locating the ureter. The two groups, differentiated by robot assistance regardless of surgical procedure, experienced approximately the same amount of blood loss and similar incision lengths to remove specimens [2].

III. SYNERGY

Future of Artificial Intelligence in Medicine

Diagnosis is a prominent term in making decisions to treat patients. A combination of patient case history and symptoms combine to help physicians diagnose illness. Doctors' education, experience, memory, and association with colleagues are the foundation for interpreting medical history and signs of illness associated with disease. Designing a neural network increases the degree of accuracy in choosing treatments. A neural network imitates doctors' diagnostic thinking; the network depends on a knowledge base of information and practice cases to learn to diagnose diseases [6].

A type of artificial intelligence, neural networks employ multiple artificial neurons joined to function as information processors. Neural networks make medical diagnosis available online by data mining patient record repositories of history and selecting information to apply to current patients.

Artificial intelligence computer applications run on neural networks with the capacity to learn from historical data. The strength of neural networks is to create deductive results from data accumulated in networks' knowledge bases. Automation to manage facilities, equipment, finance, training, and communication is valuable in medicine; however, automation to diagnose patient conditions is perhaps most valuable. Learning makes artificial intelligence applications particularly useful in diagnosing illness. Neural networks that process information compiled with data mining are likely to enable medical professionals to give patients options to view medical advice online from artificial intelligence software [6].

IV. SUMMARY

The possibility of combining advanced data collection with electronic medical records and neural networks is promising. In a medical environment focused on cancer and other life-threatening disease, every advancement is needed to find cures. The application of artificial intelligence to this battle may give new hope to those in the fight.

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